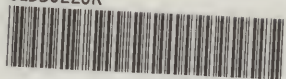


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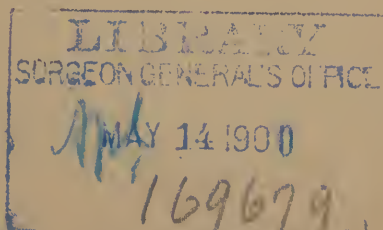
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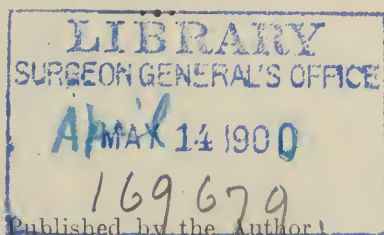
Laws of the Human Body

or

Physiology

by

Prof. J. P. Schmitz, M. D.



3321 Twenty-first Street, San Francisco, California

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PREFACE.

N. B.—A careful perusal of this Preface is especially recommended to my readers.

It is gratifying to notice that the time for the study of medicine in medical colleges has been extended to four years, which is surely not too long for one who wishes to acquire something above mediocrity in this science. In one respect, however, it may not be amiss to allude here to a serious defect in some localities of not requiring a better qualification in the knowledge of the Laws of Life.

Students intending to become physicians, have a right to demand a most thorough teaching of the laws that govern the human body. Deception in this regard is bad; and when diplomas are awarded to those who have not a thorough knowledge of physiology, it endangers human life and perpetuates conditions in the profession that keep up the danger. It is the duty of all medical examining boards to refuse licenses to applicants who are found deficient in this regard.

This work is intended, as an accompaniment to the author's book on "Human Physiology, Analysis and Digest," one of the principal features of which is, that physiology is carefully distinguished from histology. It is notorious that even in some first-class Colleges these two branches are not unfrequently confounded. What can be expected from the student when the teacher himself does not know that Physiology is the science of the **Laws** of life and **Functions** of living organisms; Histology the science of minute anatomy. It is on account of confounding these matters in text-books that the mischief is worked. The student gets confused, and at last gets to hate and shun physiology, managing to cram a few dozen answers to questions in one or two years in order to get out of it. The fact is, as the author has always experienced, that, when physiology is truthfully and comprehensively laid before students, no branch of medical knowledge is so pleasing and fascinating. The student soon

gets to feel internally that the true and thorough knowledge of the **Laws of Life** is the very **Foundation** of medical competency, diagnosis, and safety of treatment.

The conscientious student will ask himself: How shall I be able to make a sure, true diagnosis? How shall I be able to know what remedy to administer? How shall I be able to know the physiological actions of remedies? The books on *Materia Medica* and *Practice* tell me that the action is such and such, but not one tells me *how the remedies act*. How shall I be able to know whether what I observe in a patient is to be attributed to remedies or to the disease?

A common sense man says, give me a lawyer thoroughly versed in the law and I will trust my case to him. Can a lawyer ignorant of the law know when he does harm to his case? Certainly not. It is exactly the same with the physician. The practitioner, ignorant of the laws of human life, may be not inaptly compared to a blind bird; it **may** find the grain on the way-side, but the chances are against it.

The greatest responsibility falls on the medical college faculty or officers, who supply the chair of physiology with simply a book-worm. In fact, it seems very often as if any physician is thought competent to fill that chair as Professor, provided he is able to talk the hour away two or three times a week. Such a Professor cares little whether the student has fully understood him or not, or in fact whether he has understood him at all: for, if he did he would not allow students, as very often happens, to cram a few dozen questions and answers for what is termed "Examination," and then dispense with physiology for the balance of the College course.

It has often been publicly remarked, that no two physicians agree in regard to treatment. Why is this? Because if all physicians were thoroughly educated in physiology they would know positively what is required, and there would be no difference of opinion in treatment. Then the treatment of human beings would be truly scientific, but it cannot be without that knowledge. Physiology is no longer guess work; it is as positive as any other science, and the physician who does not know the Laws of life is either at fault himself or the blame falls back on his teacher. It is not due to the science.

The author for years has maintained that the time required for the study of physiology in the medical colleges is too short, and he has kept his students for the full term of college study of four

years on physiology. That he was not alone in this idea it is agreeable to notice that the College Faculty of Physicians and Surgeons, **London**, have by resolution extended the time for the study of physiology of three years, so that hereafter students are required to continue this subject for the full term of five years.

Anyone who maintains that medical students can be excused from the study of physiology before the end of their college life, knows but little about it. If he comprehended them, he would know the importance of that study.

Does the Professor on physiology ever reflect on the following:—Am I fit for the position? Do I do my duty? Am I not neglectful? Do I see that every student under my care fully comprehends the subject? Will I not be partly responsible for the acts of a physician once in my care who does more harm than good to patients, or perhaps shortens their lives on account of not having received from me thorough teaching?

On no other chair in medical colleges does the responsibility so forcibly rest as on the chair of physiology; because a doctor once out of college can easily continue the study of other branches of medical knowledge, but not that of physiology. This latter has to be acquired in the college, because to fully comprehend the laws of life, requires a thorough and practical professor to teach, to read, to explain, to illustrate a subject sometimes in many different ways, before every student fully comprehends it. Besides, the explanations and illustrations have to branch off more or less on a subject of another chair, or to several at a time, so as to make the point understood.

The so-called **Quiz-books** in the market, *i. e.*, books containing questions and **Answers** on physiology, are surely detrimental to the student in acquiring a knowledge of physiology. No man can learn any science out of quiz-books.

The **Three Thousand** and more questions in this work, have **Not** been designed to puzzle the student, nor are they intended to be learned by heart. Neither were they made in order to force the student to answer every question; but they were formulated that the student might better understand the real point contained in the text-book. A student often reads a sentence in a book on physiology, and remains in doubt as to the real point contained therein, or, perhaps he does not see anything of importance in the sentence.

It will be found that the questions in this work contain really

the gist of the various texts, and that the different sentences of the texts contain the **Answers to the Questions**. It will also be noticed that the answers (sentences in the author's text) on physiology **follow one another** in the same order as the questions. The student, therefore, can with ease understand and truly comprehend the laws governing all the organs of the human body. This work, in connection with the author's physiology, is, if I may so express it, a chewing up of the scientific food for more easy digestion by the student.

It may not be too much to assume that the author in his text-book on "Human Physiology, Analysis and Digest," 1894, is the first who ever laid down in a medical college text-book, the true fact of the following physiological laws:

First—That the **Stimulus** for respiration and circulation are the carbonic acid elements of the venous blood to the heart and lungs.

Second—That the **Acid** for the gastric juice normally originates in the lower portion of the œsophagus.

Third—That **External Sensation** lies in the sense-organ.

Fourth—That the living body comprehends an **Immaterial Vital Principle** or **Soul**.

Fifth—That all brain and spinal-cord **Nervous-centre Actions**, voluntary or involuntary on external organs, are due to **Reflex Actions** only.

Sixth—That the **Cause of the Capillary Circulation** in the animal body is peristaltic.

Seventh—That the defective mucous membrane is the **Primary Cause of Consumption**.

Eighth—That the physiological action of remedies will become an exact science as soon as physiology is truly comprehended, and not before.

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PHYSIOLOGICAL QUESTIONS.

THE FOLLOWING QUESTIONS ARE DESIGNED WITH A VIEW TO THE
THOROUGH COMPREHENSION OF THE TEXT IN

Human Physiology; Analysis and Digest,

By Prof. John P. Schmitz, M. D., San Francisco, Cal.

The *Answers* to the questions will be found in the text following one
another in that book.

INTRODUCTION.

1. Define **Physiology**? Page 23 in the above stated book.
2. Of what does an **Organism** consist? 23.
3. What are the functions of an organism? 23.
4. What is an **Organ**? 23.
5. What is understood by the function of an organ? 23.
6. What is meant by the **Organic World**? 23.
7. Upon what does **Animal** and **Vegetable Life** depend? 23.
8. Regarding accumulation of matter, how do organic bodies differ from inorganic? 23.
9. In what manner do **Inorganic** bodies enlarge? 23.
10. How do **Organic** living structures enlarge or grow? 23.
11. In regard to stability of organisms, what changes are noticeable? 23.
12. What happens to an organized body when the mutual living functions of its organs cease? 23.
13. What force keeps the organized body in form after the living functions of its organs cease? 23.
14. What is the principal vegetative active constituent of the vegetable or plant? 23.
15. What causes the decomposition of the *carbonic acid*, *ammonia*, and *water*, within the plant? 23.
16. Of what use for the plant is the decomposed carbonic acid, ammonia and water? 23.

17. What outside agent influences the chemical change or decomposition of the carbonic acid, ammonia, and water, in the plant? 23.
18. Through what influence does the carbon of the carbonic acid become fixed in the structure of plants? 23.
19. What element exhale plants useful to animals? 24.
20. In what function are all living animal and vegetable organisms alike? 24.
21. What performs the vital phenomena in organisms? 24.
22. What causes the cells of organisms to act? 24.
23. What do the cells of living organisms especially require for their proper action? 24.
24. Of how many chemical elements does our body consist? 24.
25. Name four elements found most abundantly in the human body? 24.
26. What is the percentage of hydrogen, oxygen, nitrogen, and carbon in the human body? 24.
27. Anatomically, into how many parts is the body divided? 24.
28. Name the four anatomical divisions of the body? 24.
29. Name three organs of the head? 24.
30. Name six organs of the trunk? 24.
31. Name some organs of the extremities? 24.
32. Anatomically, what constitutes a **System**? 24.
33. Anatomically, what constitutes an **Apparatus**? 24.
34. Anatomically, what is understood by **Tissue**? 24.
35. What is an **Anatomical Element**? 24.
36. Name some anatomical elements? 24.
37. Of what are the human tissues formed? 24.
38. Of what are all the parts of the human frame made up? 24.
39. What property of the anatomical elements expedites vitality or life? 24.
40. What constitutes the great secret of material vitality or life? 25.
41. What is a **Cell**? 25.
42. Name some functions of the different cells? 25.
43. What mass of formation indicates first the propagation of vital phenomena? 25.
44. What function have cells besides secreting, absorbing, repairing and reproducing? 25.
45. Has the cell a wall or inclosing membrane? 25.
46. How are the **Cells Reproduced**? 25.
47. What is the most important substance of a cell? 25.

CHAPTER I.

NUTRITION.

1. Define **Nutrition**? 26.
2. Whence are the nutritive substances of the body derived? 26.
3. Define a **Proximate Principle**? 26.
4. Name three proximate principles necessary for nutrition? 26.
5. Are the *albuminous* proximate principles of organic or inorganic origin? 26.
6. Does the animal, or the vegetable food furnish the albuminous proximate principles for our body? 26.
7. Are the *starchy*, *saccharine*, and *oleaginous* proximate principles of organic, or of inorganic origin? 26.
8. Does animal, or vegetable food furnish the starchy, saccharine and oleaginous proximate principles for our body? 26.
9. Name some *inorganic* proximate principles? 26.
10. From what are the inorganic proximate principles of the body derived? 26.
11. Of what do the *coloring matters* of the body consist? 26.
12. State the origin of the coloring matters of the body? 26.
13. Of what importance is *albuminous* food? 26.
14. Why are the albuminous matters called *nitrogenous* proximate principles? 26.
15. In what do nitrogenous proximate principles differ from non-nitrogenous? 26.
16. State the principal food substance of muscular tissues? 26.
17. Where does **Pure Albumen** naturally exist? 26.
18. What is understood by **Albuminous Matter**? 26.
19. What is **Albuminose**? 26.
20. Can albumen pure pass through animal membranes? 26.
21. Why are albuminous substances hygroscopic? 26.
22. When the moisture of albuminous substances is evaporated, to what extent can they again absorb moisture? 26.
23. When albuminous proximate principles are coagulated, is it possible for them to resume their original condition? 27.
24. How can **Albumen** be coagulated? 27.
25. How can **Casein** be coagulated? 27.

26. How can the **Fibrin** of the blood be coagulated? 27.
27. When albumen coagulates what becomes of its water? 27.
28. State the most essential constituent of vegetable tissue when used as food? 27.
29. How much albumen exists in the human blood? 27.
30. What is the physiological property of albumen in the blood? 27.
31. What becomes of the blood-albumen? 27.
32. Into how many groups are the *non-nitrogenous* proximate principles divided? 27.
33. Name the groups of non-nitrogenous proximate principles? 27.
34. What effect has **Saliva** on starch? 27.
35. What is the significance of glucose in the stomach during digestion? 27.
36. Why are **Starch, Sugar, and Fat**, termed non-nitrogenous substances? 27.
37. Of what elements do pure starch, sugar, and fat, consist? 27.
38. To what per cent is carbon present in starch, sugar, and fat? 27.
39. What effect has **Pancreatic Juice** on starchy substances during digestion? 27.
40. Is vegetable food absolutely necessary for the adult human body? 27.
41. If the adult human body was restricted to animal diet, what would be the result? 27.
42. What is the origin of the saccharine and oleaginous substances of food? 27.
43. Would saccharine, or oleaginous matter alone, be sufficient for perfect nutrition? 27.
44. In the body, what becomes of the sugar of food and that formed in the liver? 27.
45. How can we prove that sugar contains a great amount of carbon? 27.
46. What change of the sugar has taken place, after its water is evaporated on a hot stove? 27.
47. Where does **Sugar of Milk** originate? 27.
48. Where does **Liver Sugar** originate? 27.
49. State the organs in which liver-sugar is found? 28.
50. In what form is the oleaginous matter in animal substances found? 28.
51. In what form are oleaginous substances found in vegetable structures? 28.
52. What is required for the **Production of Fat** in the body? 28.

53. What change takes place to adipose vesicles or fat-cells in emaciation of the body? 28.
54. What causes **Cow's Milk** to have a pasty consistency? 28.
55. What causes the formation of **Butter** when milk is churned? 28.
56. From what is the fat of the body derived? 28.
57. Is all the fat of the body derived from oily or fatty food only? 28.
58. Of what do the **Fixed Oils** of animal and vegetable origin consist? 28.
59. What constitutes the liquid, and what the solid portion of fixed oils? 28.
60. What change, if any, does fat undergo in the stomach when taken with food? 29.
61. In what part of the alimentary canal is fat converted into a fine emulsion? 29.
62. What converts the fat of food in the intestine into a fine emulsion? 29.
63. What absorbs the fat in the intestines? 29.
64. What becomes of the absorbed fat after having entered the circulation? 29.
65. How does the transformation of fat in the vital economy **Produce Heat**? 29.
66. In regard to heat, what is the action of fat under the skin? 29.
67. Besides producing and retaining heat, of what further use is fat in the vital economy? 29.
68. When more fat is taken than the absorbent vessels are capable of taking up, what becomes of the residue? 29.
69. When starch, sugar, and fat, have served the intended purposes in the body, what becomes of them? 29.
70. What is an *inorganic* proximate principle? 29.
71. What inorganic proximate principles are the most abundantly found in the body? 29.
72. What kind of salts are partly formed in the economy? 29.
73. From what are the alkaline **Carbonates, Phosphates** and **Sulphates**, formed in the body? 29.
74. Is water changed in the body? 29.
75. With what does water unite in the body? 29.
76. From what can the body abstain the longer, from liquid, or from solid food? 29.
77. Of what use is **Water** in the body? 29.
78. What is the percentage by weight of water in the body? 30.
79. What amount of water is ordinarily introduced daily into the adult body? 30.

80. By what channels does water pass from the body? 30.
81. In a 100 parts of water passing from the body, how much passes off by the lungs? By the skin? By the kidneys? and with the feces? 30.
82. In what kinds of food is **Lime Phosphate** introduced? 30.
83. In what solids and fluids of the body is lime phosphate? 30.
84. What mineral salt is most abundantly present in the body? 30.
85. What amount of lime phosphate is in bone? 30.
86. What holds lime phosphate in solution in the blood? 30.
87. What physical property does lime phosphate give to bone? 30.
88. In what peculiar manner is lime phosphate in the body combined with all kinds of tissues? 30.
89. If lime phosphate is deficient in a child, what is the result? 30.
90. What is the result of an insufficient supply of lime phosphate in the adult? 30.
91. What holds lime phosphate in solution in urine? 30.
92. If urine is rendered alkaline by adding soda or potassa, what effect on the earthy phosphates? 30.
93. In what parts of the body is **Lime Carbonate** found? 30.
94. What is the proportion of lime carbonate, compared with that of lime phosphate, in the body? 30.
95. What holds lime carbonate in solution in the fluids? 40.
96. Of what origin is **Magnesium Phosphate** in the body? 30.
97. What tissues and fluids contain magnesium phosphate? 30.
98. What kinds of food supply **Alkaline Salts** (carbonate of soda and potassa) to the body? 31.
99. By what diet may the alkaline salts be increased or lessened in the body? 31.
100. By what food are **Phosphates** introduced into the body? 31.
101. Of what source are alkaline carbonate salts of the blood? 31.
102. How is the proper proportion of salts preserved in the body? 31.
103. How are the alkaline salts excreted? 31.
104. What diet, or food, increases the **Acidity of Tissues**? 31.
105. Next to lime phosphate, which of the mineral salts is the most abundant in animal tissues and fluids? 31.
106. What regulates the *endosmosis* and *exosmosis* of nutritive fluids through organic membranes? 31.
107. What property has **Sodium Chloride** (salt) in regard to digestive fluids? 31.
108. How is sodium chloride discharged from the body? 31.
109. Of what importance is sodium chloride in regard to the formation of gastric juice? 31.

110. In what substance is the **Most Perfect Natural Combination of Food Elements** for nutrition found? 32.
111. State the principal constituents of **Good Milk**? 32.
112. What gives milk that opaque white color? 32.
113. Why does milk not solidify by boiling? 32.
114. What causes milk to curdle? 32.
115. Why does a warm atmosphere curdle milk? 32.
116. What is the *most nutritious* combination of **Vegetable Matter** when used as food? 32.
117. Why is **Wheat** the best grain for bread? 32.
118. To make **Oat-meal** easily digestible, why should it be thoroughly boiled and strained? 32.
119. What principal ingredient does **Indian Corn** possess for the nourishment of the body? 32.
120. What constitutes the most nutritious substance of **Rice**? 32.
121. Why is **Meat** nutritious? 32.
122. Of what do the mineral salts of meat consist? 32.
123. State the composition of the **Yelk** of the **Egg**? 32.
124. State the composition of the **White** of the **Egg**? 32.
125. Of what do the mineral salts of the egg consist? 32.
126. Why are vegetables valuable to the animal as food? 32.
127. On what does the **Nutritious Value** of food depend? 33.
128. What circumstances change the requirements of food? 33.
129. Is more food required in cold than in warm weather? 33.
130. Why is **Carbon** so important in the animal economy? 33.
131. What amount of carbon is continually required to support an adult human body? 33.
132. Why is **Nitrogen** important to the human body? 33.
133. What amount of nitrogen is continually required to support an adult human body? 33.
134. What is the source of energy spent during **Fasting**? 32.
135. What is the result if more food, or nutritious elements, are introduced into the body than absolutely required? 33.
136. What is understood by **Amyloid Compounds**? 33.
137. In what do the amyloid compounds differ from protein compounds? 33.

CHAPTER II.

ACTIVE PRINCIPLES IN LIQUIDS AND SOLIDS.

1. Which are the **Most Active Principles** in the liquids and solids of the body? 34.

2. Name six fluid albuminoids? 34.
3. Name four solid albuminoids? 34.
4. Name six active principles of coloring matters of the body? 34.
5. What is the principal nutritive substance of **Milk**? 34.
6. From what substance in milk is **Cheese** formed? 34.
7. What effect has a dilute acid, or magnesium sulphate, on the casein of milk? 34.
8. In what condition of the stomach should one abstain from milk? 34.
9. What is the principal active agent in **Saliva**? 34.
10. What action has ptyalin in regard to the secretion of saliva? 34.
11. What action has saliva on moist, **Boiled-starch** of food? 34.
12. What is the quantity of saliva daily secreted in the adult? 34.
13. State the principal constituent of **Gastric Juice**? 34.
14. How does the **Pepsin** come into the gastric juice? 34.
15. What parts of pepsin in 1000 parts of gastric juice? 34.
16. On what does pepsin principally act during digestion? 34.
17. What quantity of gastric juice is daily secreted in the adult? 34.
18. State the most active constituent of **Pancreatic Juice**? 34.
19. What parts of pancreatin in 1000 parts of pancreatic juice? 34.
20. How much pancreatic juice is daily secreted in the adult? 34.
21. What is the reaction of pancreatic juice? 34.
22. What is the physiological property of pancreatic juice? 34.
23. Taking starchy food and not giving time for conversion into glucose by the saliva, what becomes of it during digestion? 34.
24. What is **Mucosin** or **Mucin**? 34.
25. What property does mucosin impart to mucus? 34.
26. Of what use is **Mucus** on the membranes? 35.
27. What is **Myosin**? 35.
28. When, after death, the myosin coagulates, how are the muscles thereby affected? 35.
29. How can the coagulation of myosin be retarded or delayed? 35.
30. What effect has an abnormally increased acidity, or alkalinity, of the body on myosin? 35.
31. What effect has an abnormally increased acidity, or alkalinity, on the muscular system? 35.
32. What tissues contain **Collagen**? 35.
33. When a tissue containing much collagen is boiled, what is the product? 35.
34. What effect has tannic acid on collagen? 35.
35. Why is tannic acid (oak-bark) used in preparing hides for leather? 35.

36. What constitutes the organic basis of **Cartilage**? 35.
37. What is **Elastin**? 35.
38. What tissues contain elastin? 35.
39. What is **Keratin**? 35.
40. What class of compounds are the **Coloring Matters** of the body? 35.
41. Which is the most abundant coloring matter of the body? 35.
42. What absorbs oxygen in the lungs? 35.
43. Where are the animal coloring matters found? 35.
44. What is **Hæmoglobin**? 35.
45. What per cent of hæmoglobin is in red blood-corpuscles? 35.
46. In what combination is oxygen carried by hæmoglobin? 35.
47. How much of iron is contained in hæmoglobin? 35.
48. What is **Melanin**? 35.
49. What tissues contain melanin? 35.
50. What gives to bile the reddish yellow or orange color? 35.
51. Where and from what is **Bilirubin** formed? 36.
52. From what is **Biliverdin** formed? 36.
53. What gives to bile the green color? 36.
54. What gives the color to urine? 36.
55. What is the normal color of fresh urine? 36.
56. What substance gives the green coloring matter to plants? 36.
57. Where is **Chlorophyll** formed? 36.
58. What is the effect of a deficiency of chlorophyll in plants? 36.
59. State the essential substance of chlorophyll? 36.
60. On what does the growth and accumulation of organic material, such as starch, sugar, and vegetable tissues, in the plant depend? 36.
61. What is **Urea**? 36.
62. In what secretion is urea mostly found? 36.
63. Besides urine, in what other secretion is urea found? 36.
64. Does urea, as such, normally exist in the blood and tissues? 36.
65. Where is urea completely formed? 36.
66. Under what condition of the body may urea be found in blood, lymph, and tissues? 36.
67. What amount of urea is in urine? 37.
68. What amount of urea may sometimes be in blood? 37.
69. What amount of urea is excreted daily by an adult? 37.
70. At what time, during the 24 hours, is urea produced in larger quantity? 37.
71. What class of food increases the amount of urea? 37.
72. What class of food diminishes the amount of urea? 37.

73. Does the amount of urea formed depend on food only? 37.
 74. Where is uric acid found? 37.
 75. What is **Uric Acid**? 37.
 76. Where is uric acid formed? 37.
 77. From what is uric acid formed? 37.
 78. What are the principal bases of uric acid? 37.
 79. What difference in amounts of uric acid and urea formed by a vegetable, or an animal food diet? 37.
 80. How much uric acid is excreted by an adult in 24 hours? 37.
 81. What is the proportion of uric acid to urea excreted? 37.
 82. Of what are **Urinary Gravel** and **Calculi** generally composed? 37.
 83. Why is urine not absorbed by the urinary bladder? 37.
 84. Why does bathing in fresh water relieve thirst, but not in strong salt water? 37.
-

CHAPTER III.

THE MUCOUS MEMBRANE AND EPITHELIUM.

1. Why is it important that the physician should thoroughly understand the structure and physiological functions of **Mucous Membranes**? 38.
2. State the most important structure of the body through which the proper nourishment is accomplished? 38.
3. If more attention were paid by physicians to the mucous membranes, to their structure, importance, and maintenance in a normal, healthy condition, would not **Consumption**, which now is the most fatal disease, become the least fatal? 38.
4. When the mucous membrane of the alimentary canal is defective, what is the effect on the body? 38.
5. Why is the mucous membrane of the lower portion of the œsophagus the most exposed to inflammation? 38.
6. What is the general cause of an abnormally acid condition of the gastric juice? 38.
7. What is a **Ptomaine**? 38.
8. In what tissues of the body are ptomaines soonest and most easily developed? 38.
9. What is a **Saprophyte**? 39.
10. What is a **Pathogenyte**? 39.
11. In what tissue of the body do saprophytes and pathogenytes find a most favorable soil for development? 39.

12. How can the product of a ptomaine, developed in the mucous membrane of the body, enter the lungs? 39.
13. Why are the lungs more easily affected by an absorbed ptomaine than any other organ? 39.
14. If physicians studied the structure and functions of mucous membranes more, and the primary cause of consumption; would they bother their heads about **Koch's Bacilli**? 39.
15. If the mucous membranes had always been properly attended to, would the word **Tuberculosis** ever have come into existence? 39.
16. What is the structure of **Mucous Membranes**? 39.
17. Of what does the free outer layer of mucous membrane consist? 39.
18. Where are the **Mucous** membranes found? 39.
19. Where are the **Serous** membranes found? 39.
20. What do the cells of mucous membranes secrete? 39.
21. Of what does **Mucus** consist? 39.
22. What is the property of mucus? 39.
23. Physically, in what does mucus differ from the fluid of serous membranes? 39.
24. Is the mucous membrane simply a straight continuous covering in the various localities? 39.
25. In what do the depressions of the mucous membrane differ? 39.
26. Why is not the mucous membrane injured when the stomach, uterus, or bladder, are distended? 39.
27. Where does the mucous membrane of the alimentary canal commence, and end? 39.
28. What furnishes the **Digestive Secretions** for the reduction of food? 39.
29. What absorbs the nutritious materials of chyle? 40.
30. What produces the **Saliva**? 40.
31. Where is the **Acid** of the gastric juice produced? 40.
32. What produces the **Pepsin** of the gastric juice? 40.
33. What produces the **Intestinal Secretions**? 40.
34. What is the function of the large intestine? 40.
35. State the parts of the head covered with mucous membrane? 40.
36. Through what membrane are the alimentary and respiratory nutritious materials absorbed? 40.
37. What secretes the digestive fluids of the follicles and glands of the alimentary mucous membrane? 40.
38. How far does the respiratory mucous membrane extend from the larynx and trachea? 40.

39. What is the diameter of a **Bronchial Tubule**? 40.
40. What membrane lines the **Pulmonary Alveoli** (air-cells)? 40
41. What becomes of the mucus secretion in congestion of the pulmonary mucous membrane? 40.
42. What medicines increase the mucous secretion in bronchial tubes? 40.
43. What medicines diminish the mucous secretion in bronchial tubes? 40.
44. In how many ways do expectorants operate in expelling copious secretions from bronchial tubes? 40.
45. Explain the nervous operation of expelling mucus from bronchial tubes by local stimulus on the gastro-œsophageal mucous membrane? 40.
46. Explain the nervous operation of expelling mucus from bronchial tubes by remedies which change the secretions at the same time? 41.
47. By what can the use of medicines for expelling mucus from bronchial tubes be assisted? 41.
48. To what organs does the genito-urinary mucous membrane extend? 41.
49. What influence has a congested and inflamed mucous membrane on its mucous secretions? 41.
50. What causes an abnormally increased and acid secretion by the epithelial cells of the mucous membrane? 41.
51. Why is the food in the lower portion of the œsophagus more or less retained? 41.
52. Where does the **Acid** originate for the gastric juice? 41.
53. What is the cause of an increased acid secretion in the œsophagus and stomach? 41.
54. To what class of acids does **Vital Tissue Acid** belong? 41.
55. What is the reaction of the normal secretions of the small intestines? 41.
56. What is the result when the stomach is continually irritated and abnormally acid? 41.
57. What kind of food and drink **Increase** the **Acidity** of the **Stomach** and produce softening of the membrane? 41.
58. What is generally the cause of **Indigestion** and **Starvation** (consumption) of the body? 42.
59. How may an artificial gastric juice be produced? 42.
60. When the acid secretion of the œsophagus is abnormally increased, what is the result? 42.
61. Of what does **Endothelium** consist? 42.

62. Where is endothelium found? 42.
63. State some parts lined with endothelium? 42.
64. To what variety or class of cells do endothelium cells belong? 42.
65. Of what does **Epithelium** consist? 42.
66. Where is epithelium found? 42.
67. What is understood by free surface of a cavity or vessel? 42.
68. How many varieties of epithelial cells are there? 42.
69. What functions have epithelial cells? 42.
70. How is the surface of the epithelial lining kept moist? 43.
71. What is the principal constituent of mucus? 43.
72. How is nitrogen principally eliminated from the system? 43.
73. Of what do the **Ciliated** epithelial cells consist? 43.
74. What is the length of the cilia of ciliated epithelial cells? 43.
75. How many times do the cilia of ciliated cells vibrate per minute? 43.
76. What is the function of the vibrating cilia of cells? 43.
77. Where are the ciliated cells found? 43.
78. About how many cilia has each ciliated cell? 44.
79. Of what do the **Columnar** epithelial cells consist? 44.
80. What is the length of columnar epithelial cells? 44.
81. Where are the columnar epithelial cells found? 44.
82. What is understood by **Goblet Cells**? 44.
83. Of what do **Squamous** epithelial cells consist? 44.
84. Where are the squamous epithelial cells found? 44.
85. Of what do the **Tessellated** epithelial cells consist? 44.
86. Where are the tessellated epithelial cells found? 44.
87. Of what do the **Glandular** epithelial cells consist? 44.
88. Where are the glandular epithelial cells found? 44.
89. What is the function of glandular epithelial cells? 44.
90. Where are the **Transitional** epithelial cells found? 45.
91. How are the various epithelial cells arranged in position? 45.
92. In what manner do epithelial cells change, and be cast off? 45.

CHAPTER IV.

DIGESTION.

1. What organs are included when we speak of **Digestive Organs**? 46.
2. What organs are included in the **Digestive Apparatus**? 46.
3. What is understood by **Digestion** of food? 46.
4. Is digestion a mechanical or chemical process? 46.

5. Of what is food proper, composed? 46.
6. How does the nourishment of animal life differ from that of vegetable life? 46.
7. What is understood by **Alimentary Canal**? 46.
8. By what is the alimentary canal divided into several compartments? 46.
9. What guard is there between the mouth and œsophagus? 46.
10. What guard is there between the œsophagus and stomach? 46.
11. What guard exists between the stomach and pylorus? 46.
12. What is the length of the small intestine in the adult? 46.
13. State the subdivisions of the small intestine? 46.
14. What orifices of ducts are in the duodenum? 46.
15. Where is the **Ileo-cæcal Valve**? 46.
16. Where is the **Sigmoid Flexure**? 46.
17. What constitutes the guard at the **Anus**? 46.
18. What prevents the regurgitation of the ingesta from the large into the small intestine? 46.
19. What is the length of the **Colon** or **Large Intestine** in the adult? 47.
20. What is the difference between the contents of the large intestine and those of the small intestine? 47.
21. Where is the **Vermiform Appendix**? 47.
22. What is the function of the vermiform appendix? 47.
23. Of what use is the alkaline secretion of the vermiform appendix? 47.
24. Of how many layers does the **Stomach** consist? 47.
25. State the four layers of the stomach? 47.
26. What is the thickness of the wall of the stomach in adult? 47.
27. How are the muscular fibres of the stomach arranged? 47.
28. What average capacity has the fully distended adult stomach?
29. What vessels are in the wall of the stomach? 47.
30. How are the secreting follicles of the stomach arranged? 47.
31. What length are the follicles of the stomach? 48.
32. How do the follicles in the wall of the stomach terminate? 48.
33. What is the diameter of the mouth of the duct of stomach follicles? 48.
34. What kind of cells are imbedded in the wall of each follicle of the stomach? 48.
35. What kind of cells cover the surface of the mucous membrane of the stomach? 48.
36. What secretes the mucus that covers the membrane of the stomach? 48.

37. When are the mucus secreting cells of the stomach active? 48.
38. When are the pepsin secreting cells of the stomach active? 48.
39. What is the normal stimulus for the secretion of pepsin, and peristaltic action of the stomach? 48.
40. What organs does an **External Sensation** require? 48.
41. How does stimulation of food bring about dilatation of the capillary vessels of the stomach? 48.
42. Of what benefit is the normal dilatation of the capillary blood-vessels of the stomach? 48.
43. How does stimulation of food bring about **Peristaltic Action** of the stomach? 48.
44. Why is peristaltic action of the stomach essential to digestion? 48.
45. How is the **Digestion of Food** effected? 48.
46. Why is **Mastication** of food essential? 49.
47. What changes **Starch** into glucose? 49.
48. What active principle of the saliva effects the change of starch into glucose? 49.
49. In what condition must starch be to become transformed into glucose by the saliva, or by pancreatic juice? 49.
50. Name some articles of food which contain much starch? 49.
51. Why cannot the gastric juice of the stomach change starch into glucose? 49.
52. Has dextrine nutritive properties like glucose? 49.
53. Explain the movements of the stomach during the digestive process? 49.
54. What is **Chyme**? 49.
55. Of what reaction is the normal secretion of the mucous membrane of the empty stomach? 49.
56. If the action of digestion in the stomach is too prolonged, or too often repeated, what is the consequence? 49.
57. Why is it that food during disease is not properly digested? 49.
58. How can strong **Mental Disturbances** affect digestion? 50.
59. What is **Gastric Digestion**? 50.
60. What is the stomach's temperature for proper digestion? 50.
61. What effect has moderate exercise before, or rest after eating, on digestion? 50.
62. What becomes of the pepsin and acidity of chyme when they pass from the stomach into the duodenum? 50.
63. How is **Chyle** produced? 50.
64. Into what are the **Peptones** of chyme transformed? 50.
65. How do the albumen, fibrin, and other essential material of the blood, get into existence? 50.

66. From what do the cells of secreting follicles and glands secrete the active principles of secretions? 50.
67. What is an **Albuminoid**? 50.
68. State some albuminoids? 50.
69. Why is it important that food be properly masticated and digested? 50.
70. How many secreted fluids act on food in the alimentary canal?
71. State the **Five Secretions** acting on food in the alimentary canal? 50.
72. What is the origin of the **Acid** of gastric juice? 51.
73. What kind of acid is it that becomes transformed, and, when changed, constitutes a part of the gastric juice? 51.
74. What changes the vital tissue acid of the stomach into **Hydrochloric Acid**? 51.
75. Is the **Vital Tissue Acid** for gastric juice always changed into hydrochloric acid? 51.
76. What secretes the **Pepsin** of the gastric juice? 51.
77. What condition is required in the stomach before pepsin can act on food? 51.
78. What is first secreted—the **Acid**, or **Pepsin**—of the gastric juice? 51.
79. What normally neutralizes the acid of the œsophagus? 51.
80. Why is expectoration of saliva soon after meals, injurious? 51.
81. When the œsophagus is in an abnormal acid condition, would it be proper to treat the stomach for **Indigestion** or **Dyspepsia**? 51.
82. In what condition of the stomach is the administration of diluted hydrochloric acid beneficial? 51.
83. What causes an insufficiency of acid in gastric juice? 51.
84. What kinds of food and drink are injurious when the mucous membrane in the alimentary canal is defective? 52.
85. What is **Pepsin**? 52.
86. What is the action of pepsin? 52.
87. What class of food is acted upon by pepsin? 52.
88. How are **Peptones** produced during digestion? 52.
89. What part of the gastric juice—the acid or the pepsin—affects the solution of food, and what part the conversion? 52.
90. Is the digestion of food completed in the stomach? 52.
91. What happens to peptones coming in contact with intestinal juices? 52.
92. State the only alimentary secretion capable of producing a natural peptone? 52.

93. At what stage, during the process of digestion, are the peptones formed, and when do they disappear? 53.
94. Who was the first to call certain constituents of chyme, peptones? 53.
95. How can albumen be distinguished from albumen-peptone? 53.
96. What neutralizes the acidity of chyme entering the intestine? 53.
97. What secretion acts on the pepsin of chyme when it enters the intestine? 53.
98. Are peptones, as such, absorbed? 53.
99. How are the substances, **Albuminose**, **Fibrinose**, and **Globulose**, produced? 53.
100. What is the difference between **Albumen**, **Albuminous**, **Albuminose**, and **Albuminoid**? 53.
101. Is the change of food substances in the alimentary canal into albuminose, fibrinose, globulose, and other solutions, a chemical, or physical change? 53.
102. What difference between a **Chemical**, and **Physical** change?
103. Give two illustrations of physical change? 53.
104. How are **Albuminoids** produced? 54.
105. How is the albuminoid **Hæmoglobin** produced? 54.
106. What produces the albuminoids of digestive juices? 54.
107. What produces the albuminoids **Myosin**, and **Chondrin**? 54.
108. Where do the cells producing albuminoids get materials for their secretions? 54.
109. Into how many classes are the albuminoids divided? 54.
110. Are the albuminoids of the fluids and solids similar in composition, properties, and action? 54.
111. What is the action of albuminoids of juices? 54.
112. What is the action of albuminoids of the solid tissues? 54.
113. What vegetable **Alkaloids** are analagous to animal solid **Albuminoids**? 54.
114. What is an **Albuminoid**, and what are its elements? 54.
115. What other term is sometimes applied to albuminoids? 54.
116. In what are the albuminoids alike in composition, and in what do they differ? 54.
117. Why are not albuminoids identical with the substances from which they have been derived? 54.
118. What is the general chemical composition of an albuminoid? 54.
119. What action has **Bile** on **Pepsin**? 55.
120. What results when bile enters the stomach? 55.
121. How is **Indigestion** generally produced? 55.
122. What action has tannic acid on digestion in the stomach? 55.

123. Name some substances that are generally absorbed by the stomach? 55.
124. Into what organ do the substances absorbed by the veins of the stomach pass? 55.
125. How may nutritive and other substances be introduced into the body without passing through the stomach? 55.
126. How may life be sustained when no food can be taken into the stomach? 55.
127. By what are substances absorbed when applied on the skin? 55.
128. Is a **Chemical Change** of nutritious substances absolutely necessary before absorption? 55.
129. In what condition must nutritious substances be before they can be absorbed by the skin? 55.
130. Why can lacteals of the intestine absorb nutritious substances more thoroughly than the lymphatics of the skin? 55.
131. What substances are normally absorbed by the **Lacteals**? 55.
132. What substances are principally absorbed by the **Capillary Veins** of the intestinal wall? 56.
133. How many reasons may be assigned why the **Stomach** does not **Digest Itself**? 56.
134. State the four reasons why the stomach does not digest itself? 56.
135. What is the result when **Pepsin** is administered into the empty stomach? 56.
136. Under what condition may the stomach become perforated, or partly digest itself? 56.
137. What is **Chyme**? 56.
138. By what is chyme acted upon in the intestine? 56.
139. Is digestion of food performed by the stomach only? 56.
140. How does chyle come into existence? 56.
141. What is **Chyle**? 56.
142. What is understood by the *molecular basis of chyle*? 56.
143. Where are the fibrin elements of chyle first formed? 56.
144. Where do the **White Blood-corpuscle** (*leucocytes*) originate? 56.
145. Into what vessel is the chyle discharged? 56.
146. Where is the **Duodenum** located? 57.
147. What is the length of the duodenum? 57.
148. Where, in the intestine, does the common bile duct (*ductus communis choledochus*) discharge its contents? 57.
149. Where are the orifices of the pancreatic ducts? 57.
150. What is the length of the small intestine? 57.
151. Of how many layers is the wall of the intestine composed? 57.
152. How are the muscular fibres arranged in the intestinal wall? 57

153. How is the peristaltic action of the intestine accomplished? 57.
154. What is the **Stimulus** for the peristaltic action of the intestine?
155. Explain the **Nervous Phenomena** involved in the production of intestinal peristalsis? 57.
156. What covers the mucous membrane of the small intestine? 57.
157. What lines the surface of the **Villi** of the small intestine? 57.
158. For what purpose is the small intestine covered with *villi*? 57.
159. What vessels are within each *villus*? 57.
160. At what part of the intestine are the *villi* most numerous and highly developed? 57.
161. In what state are the *villi* of the intestine during the process of digestion, and during prolonged fasting? 57.
162. What is the estimated surface of the small intestine? 58.
163. What is the estimated number of *villi* in the small intestine? 58.
164. In what layer of the intestinal wall are the **Follicles** of **Lieberkühn**? 58.
165. In what layer of intestinal wall are the **Glands of Brunner**?
166. In what portion of the intestine are the *Glands of Brunner* found? 58.
167. Where are the solitary glands found? 58.
168. What is a **Solitary Gland**? 58.
169. What is the size of solitary glands? 59.
170. How do the solitary glands discharge their contents? 59.
171. What is understood by **Valvulæ Coniventes**? 59.
172. For what purpose are the valvulæ coniventes placed in the intestine? 59.
173. What is understood by **Peyer's Glands**? 59.
174. Where are the Peyer's glands found? 59.
175. What is the long diameter of Peyer's glands? 59.
176. What is the number of Peyer's glands? 59.
177. What is the function of Peyer's glands? 59.
178. In what diseases do the Peyer's glands generally ulcerate? 60.
179. By what are the villi, the secreting follicles and glands, in the intestinal wall nourished? 60.
180. State the reason and importance why the venous capillaries are weaker than the arterial, especially in the walls of the stomach and intestines? 60.
181. What is the **Normal Stimulus** for gastric and intestinal peristaltic actions? 60.
182. Of what benefit are gastric, and intestinal peristalsis? 60.
183. What effect has excessive irritation on the intestinal wall, regarding absorption? 60.

184. What actions occur at the wall of intestine during diarrhœa? 60.
185. Why does severe **Diarrhœa**, or **Cholera**, soon terminate fatally? 60.
186. How is mucous membrane of the large intestine constructed? 61
187. What blood-vessels act as absorbents in the walls of the stomach and intestines? 61.
188. What does hunger and thirst indicate? 61.
189. What is the surest criterion of the quantity of food or drink naturally required by the body. 61.

CHAPTER V.

LIVER, BILE, AND PANCREATIC JUICE.

1. To what class of organs does the **Liver** belong? 62.
2. Which is the largest gland in the body? 62.
3. Where is the liver situated? 62.
4. How is the liver retained in position? 62.
5. What is the weight of the salivary glands taken together? 62.
6. What is the weight of the pancreas? 62.
7. What is the weight of the liver? 62.
8. Of what does the liver consist? 62.
9. What constitutes *Gleason's capsules*? 62.
10. Of what does the **Bile-secreting Apparatus** consist? 62.
11. In what are the bile-secreting cells of the liver situated? 62.
12. What is the diameter of the bile-secreting cells? 62.
13. How are the bile-secreting cells in the lobules arranged? 62.
14. What separates the bile-secreting cells from capillary vessels? 62
15. What supplies the liver with blood? 62.
16. Of what is the **Hepatic Artery** a branch? 62.
17. What structures of the liver are supplied by the hepatic artery? 62
18. From what is the **Bile** secreted? 62.
19. From what is the **Bilirubin** formed? 62.
20. From what organ are the elements derived for the formation of bilirubin? 62.
21. What vessels unite and form the **Portal Vein**? 62.
22. From what organs does the portal vein receive venous blood carried to the liver? 62.
23. How do the glycogen, albuminose, organic and inorganic salts, get into the liver? 62.
24. From what is the **Liver-sugar** formed? 63.
25. How does the portal vein subdivide in the liver? 63.

26. From what do the **Hepatic Veins** arise? 63.
27. What is the difference of functions of **Hepatic Cells**? 63.
28. What effete substances are removed from arterial blood by the secretion of bile? 64.
29. What deleterious substances are removed from arterial blood by the kidneys? 64.
30. For what use is the **Gall-bladder**? 64.
31. At what time does the gall-bladder discharge its contents? 64.
32. What is the physical appearance of bile? 64.
33. Of what reaction is bile? 64.
34. What is the specific gravity of bile? 64.
35. What is the **Composition of Bile**? 64.
36. When does the secretion of bile take place? 64.
37. At what time is bile most abundant and completely secreted? 64.
38. What causes the bile in bile-ducts, and the blood in capillary vessels, to move, or circulate in the liver? 64.
39. What assists bile and blood in the large hepatic vessels to flow?
40. What is the office of the two **Hepatic Veins**? 64.
41. What is the office of the **Bile-ducts**? 64.
42. What quantity of bile is secreted in the adult during 24 hours? 64.
43. What effect has bile on the contents of the intestines? 64.
44. What becomes of bile in the intestines? 65.
45. What becomes of the **Salts of Bile** in the intestines? 65.
46. When the bile-ducts are obstructed, what effect has that on the intestines? 65.
47. What is the result on the body of an abnormally increased secretion of bile? 65.
48. What results to nutrition when no bile enters the intestine? 65.
49. What imparts to bile its sticky consistency? 65.
50. What causes **Biliousness**? 65.
51. What may cause a resistance to the flow of bile from the liver? 65.
52. What is the cause of **Jaundice**? 65.
53. What effect has jaundice on intestinal peristalsis? 65.
54. Why does constipation accompany jaundice? 65.
55. When bile enters the blood, what is the effect on the pulse, respiration, and temperature? 65.
56. How does bile, when in the blood, produce the effect on the pulse, respiration, and temperature? 65.
57. Physiologically, in what manner do **Veratrin**, and **Aconitin**, act on the body? 65.
58. What effect has an **Ether Spray** on the local sensitiveness of the skin? 65.

59. How are **Biliary Calculi** or **Gall-stones** produced? 65.
60. What is the cause of jaundice in the **Newly-born** infant? 65.
61. What is the result when the glandular cells of the liver contain an abnormally increased quantity of oil globules? 65.
62. What results when bile enters the stomach? 65.
63. Why should the bowels be kept open when administering **Hepatic Stimulants**? 66.
64. In what part of the alimentary canal are the hepatic remedies generally absorbed? 66.
65. Where do the **Veins** of the stomach discharge their contents? 66.
66. State some remedies that stimulate more or less hepatic cells? 66.
67. State some remedies that stimulate more or less both the liver and the intestinal follicles and glands? 66.
68. State some remedies which stimulate the intestinal follicles and glands, but not the liver? 66.
69. What remedy **Depresses** the biliary secretions? 66.
70. How many different actions does bile exert on the contents of the intestines? 66.
71. State the **Five-fold Actions** of bile on the contents of the intestines? 66.
72. What becomes of that part of starch which is not transformed into glucose by the saliva and pancreatic juice? 66.
73. From what is **Liver-sugar** formed? 66.
74. State the two ways in which sugar is formed in the economy? 66.
75. What is the quantity of sugar in the blood? 66.
76. What becomes of sugar in the blood? 67.
77. If from any cause the quantity of sugar is abnormally increased in the blood, what is the effect on the urine? 67.
78. State the causes that may produce a **Diabetic Condition** of the economy? 67.
79. In what condition is the urine during **Diabetes Mellitus**? 67.
80. Whence are the **Nerve-fibres** supplying the liver derived? 67.
81. By what is the **Hepatic Plexus** formed? 67.
82. What part of the liver do the nerve-fibres of the hepatic plexus supply? 67.
83. What is the **Normal Stimulus** in the liver for **Continual Secretion** of bile? 67.
84. State the **Nervous Phenomenon** for continual secretion of bile? 67.
85. How may bile-secretion be increased, or diminished? 67.
86. In what manner is the liver supplied with **Lymphatics**? 67.
87. What is the **Pancreas**? 67.

88. What is the structure of the pancreas? 67.
89. Where is the pancreas situated? 67.
90. How are the ducts of the pancreas arranged? 67.
91. Where do the **Pancreatic Ducts** discharge? 67.
92. Where does the common-bile-duct discharge into the intestine?
93. What amount of **Pancreatic Juice** is daily secreted by an adult? 68.
94. When is the pancreatic juice secreted? 67.
95. What is the principal active agent of pancreatic juice? 67.
96. What amount of pancreatin is present in pancreatic juice? 68.
97. What is the physical appearance of pancreatic juice? 68.
98. What is the reaction of pancreatic juice? 68.
99. What is the chemical composition of pancreatic juice? 68.
100. What is the action of pancreatic juice? 68.
101. What is the action of the stomach on fatty matter? 68.
102. What acts principally on fatty matters in the intestines? 68.
103. When are fatty matters ready for absorption by the lacteals? 68.
104. What becomes of starch in the intestines? 68.
105. How is the pancreas supplied with arterial blood? 69.
106. Where do the pancreatic veins discharge? 69.
107. Where do the pancreatic lymphatics discharge? 69.
108. What is the nerve-supply of the pancreas? 69.
109. In what nerves do the pancreatic nerve-fibres (sensory and motor) run? 69.
110. What kind of an organ is the **Spleen**? 69.
111. Size considered, which is the most vascular organ of the body? 69
112. Of what size and weight is the spleen? 69.
113. Where is the spleen situated? 69.
114. How is the spleen held in position? 69.
115. With what organ is the spleen in close contact? 69.
116. What are the investments of the spleen? 69.
117. How does the spleen receive nourishment? 69.
118. Where is the venous blood of the spleen discharged? 69.
119. Of what is the pulp of the spleen composed? 69.
120. What is the size of the colorless nucleated cells of the spleen? 69
121. What constitutes the *parenchyma* of the spleen? 69.
122. Where do the lymphatic vessels of the spleen arise? 69.
123. Is the spleen absolutely necessary to life? 69.
124. How many functions has the spleen? 69.
125. State the four different functions of the spleen? 69.
126. Does the spleen produce new blood-corpuscles? 70.
127. What changes do red blood-corpuscles undergo in the spleen? 70

128. What becomes of the hæmoglobin and oxygen released from red blood-corpuscles of the spleen? 70.
129. How are the *diverticula* of the spleen formed? 70.
130. Of what use are the *diverticula* of the spleen? 70.
131. What condition of the liver causes enlargement of the spleen? 70
132. What condition of the intestine may cause enlargement of the spleen? 70.
133. In the normal condition of the body, when is the spleen enlarged, and when is it contracted? 70.
134. Whence does the liver receive materials for the secretion of bile when no digestion is going on? 70.
135. In what condition is the spleen during prolonged fasting? 70.
136. For what is the spleen a reservoir, or storehouse? 70.
137. When the spleen is enfeebled or removed, what may easily result? 70.
138. In what way may **Apoplexy** be relieved most quickly? 70.
139. In what disease is the spleen generally enlarged? 70.

CHAPTER VI.

SECRETION AND EXCRETION.

1. What is **Secretion**? 71.
2. How many forms of secretion are there in the body? 71.
3. State the four forms of secretion? 71.
4. State some secretions of the **Solid** form? 71.
5. State some secretions of the **Semi-solid** form? 71.
6. State some secretions of the **Fluid** form? 71.
7. State the **Gaseous** secretion? 71.
8. How are the secretions produced? 71.
9. State some secretions that are deposited and remain in the tissues? 71.
10. State some secretions for immediate action on other matter? 71.
11. State some secretions that are excreted? 71.
12. How are the secreting cells in bones and muscles situated? 71.
13. How are the secreting cells placed in mucous and serous membranes, in Lieberkühn follicles, and in ducts? 71.
14. In what form are the secreting cells placed of Brunner's glands, of the pancreas, and salivary glands? 71.
15. State the **Two Great Classes** of secreting glands? 71.
16. State some secreting glands with ducts? 71.

17. State some secreting glands without ducts? 71.
18. State some secreting glands racemose (clustered, grape-bunch-like) in form? 71.
19. State some secreting glands of the solid form? 71.
20. What is the **Source of Nourishment** of secreting glands? 71.
21. Do all secreting cells receive their material from arterial blood only? 71.
22. Are the secretions, as such, formed in the blood, or how are they produced? 71.
23. How does protoplasm of cells accomplish secretion? 71.
24. What is the principal active agent of secreting organs? 72.
25. **How Many Classes** of nerve-fibres supply secreting organs? 72.
26. What is the action of **Sensory** nerve-fibres in regard to secretions? 72.
27. What reflex centre of the brain acts on all secreting organs? 72.
28. What action have **Motor** nerve-fibres on secreting organs? 72.
29. **How Many Kinds of Impulses** are carried by motor nerve-fibres to secreting organs? 72.
30. State the four kinds of impulses carried by motor nerve-fibres to secreting organs? 72.
31. What action has an impulse through **Vaso-motor** nerve-fibres on secreting organs? 72.
32. What action has an **Inhibitory** impulse on secreting organs? 72.
33. When do the vaso-motor, or inhibitory impulses on secreting organs, take place? 72.
34. When do the impulses of the **Trophic** nerve-fibres on secreting organs take place? 72.
35. What is the proof that there are **Four Kinds** of motor impulses to secreting organs? 72.
36. In what state are the secreting organs during activity? 73.
37. What is the stimulus on **Sensory** nerve-fibres in secreting organs? 73.
38. Describe the **Nervous Phenomenon** when a secreting organ is active, or inhibited by mental influence? 73.
39. Are the cells of the cerebral convolutions in direct communication with secreting organs? 73.
40. Is the **Mind-influence** on secreting organs direct, or by reflex? 73.
41. What is the **Stimulus** for the secretion of saliva? 73.
42. What is the **Stimulus** for the secretions of the œsophagus, the stomach, and intestines? 73.
43. What is the **Normal Stimulus** for the liver and pancreas for active secretions? 73.

44. Explain the **Nervous Phenomenon** when a very hot drink in the œsophagus and stomach, or mental excitement, or depression, causes perspiration? 73.
45. What nerve-fibres (sensory or motor) pass through sympathetic **Ganglia** before arriving at the medulla oblongata? 73.
46. What nerve-fibres (sensory or motor) pass from the medulla oblongata to sympathetic **Plexus** before entering the secreting organs? 73.
47. Why is the venous blood of secreting organs of higher temperature than arterial? 73.
48. State **Four Fluids** of the body with acid reaction? 73.
49. State **Ten Fluids** of the body with alkaline reaction? 73.
50. What acid secretion becomes neutralized in the body? 73.
51. Why are all secretions that remain acid excreted from body? 74
52. What is **Excretion**? 74.
53. What vessels collect the decomposed and broken-up tissues? 74.
54. By what route are the decomposed and broken-up tissues carried to the organs of elimination? 74.
55. State some organs that are **Secretory**, but not excretory? 74.
56. State some organs that are **Secretory and Excretory**? 74.
57. State four reasons why the separation of urine elements from the blood is not a simple filtering process? 74.
58. Why is it necessary that the decomposed matters of the body be rapidly carried off? 74.

CHAPTER VII.

THE ABSORBENT SYSTEM.

1. Of what does the **Absorbent System** consist? 75.
2. What is the function of the absorbents? 75.
3. Of what does the **Lymphatic System** consist? 75.
4. To what parts of the body do the lymphatic vessels extend? 75.
5. What is the function of the lymphatic vessels? 75.
6. In what direction do the lymphatic vessels lead or carry the lymph? 75.
7. To what system do the **Lacteals** belong? 75.
8. By what is the **Chyle Absorbed**, and where is it carried to? 75.
9. What is the *receptaculum chyli*? 75.
10. By what is the **Thoracic Duct** formed? 75.
11. Why are the lymphatics that absorb chyle termed lacteals? 75.
12. What is **Chyle**? 75.

13. Where is the chyle found? 75.
14. Why must the chyle be in an alkaline condition before absorption and endosmosis? 75.
15. Where does the absorbed chyle pass to? 75.
16. Where does the thoracic duct empty the lymph into the general circulation? 75.
17. By what is the passage of liquid foods through the intestinal mucous membrane controlled? 75.
18. By what is the secretion of the intestinal fluids accomplished? 75.
19. Is the secretion and absorption of the intestinal fluids accomplished by one class of cells only? 75.
20. Name the cells that accomplish **Secretion** in the intestine? 75.
21. Name the cells that accomplish **Absorption** in the intestine? 76.
22. What is understood by the *molecular basis of chyle*? 76.
23. On what does the whiteness and opacity of chyle depend? 76.
24. When are the lacteals distended, and when contracted? 76.
25. **By How Many Routes** are the products of digestion carried into the circulation? 76.
26. Name the route by which the **Blood** from the intestines is conveyed into the circulation toward the heart? 76.
27. Name the route by which the **Chyle** is conveyed toward the heart? 76.
28. What substances of digested materials are contained in absorbed chyle? 76.
29. What is the composition of the contents of the thoracic duct? 77.
30. What is the origin of the white blood-corpuscles contained in the thoracic duct? 77.
31. Is water readily absorbed by the intestines? 77.
32. Why does a strong solution of salt, such as **Sulphate of Magnesia**, physic? 77.
33. Is an alkaline, or acid, condition of the intestine required for the **Absorption of Fat**? 77.
34. Why does fat taken in large quantity into the body **Physic**? 77.
35. What is **Lymph**? 77.
36. What is the physical appearance of lymph? 77.
37. What is the reaction of lymph? 77.
38. What is the specific gravity of lymph? 77.
39. What is the composition of lymph? 77.
40. Why does lymph coagulate like blood? 77.
41. What causes the flow of lymph in vessels? 77.
42. How much lymph is daily absorbed in an adult? 77.
43. What is the origin of lymph? 77.

44. What becomes of lymph in the body? 77.
45. What is the physical appearance of the lymphatic vessels? 77.
46. How are the **Lymphatic Vessels** arranged? 77.
47. Where is the superficial set of lymphatic vessels found? 77.
48. Where is the deep set of lymphatic vessels found? 77.
49. How and where do the lymphatic capillaries originate? 77.
50. By what is the metamorphosis of the tissues and the quantity of lymph increased? 78.
51. What is the size of **Lymphatic Glands**? 78.
52. Where are the lymphatic glands situated? 78.
53. What kind of **Blood-corpuscles** are produced in lymphatic glands? 78.
54. Where of the body are the lymphatic glands most numerous? 78.
55. What is understood by **Bubo**? 78.
56. What parts of the body have no lymphatic vessels? 78.
57. Whence is the origin of lymph that enters the left subclavian vein? 78.
58. Where does the lymph from the head, neck, and right side of the chest and arm, enter the circulation? 78.
59. Where do the absorbed substances (chyle, lymph) of the body, with the venous blood, enter the heart? 78.
60. What is **Osmosis**? 78.
61. What is **Endosmosis**? 78.
62. What is **Exosmosis**? 78.
63. Is egg-albumen osmotic? 78.
64. What is required for egg-albumen to become osmotic? 78.
65. What is **Catalysis**? 78.
66. What is **Dialysis**? 78.
67. How is **Œdema** produced? 78.
68. How is **Anasarca**, or **Dropsy**, produced? 78.

CHAPTER VIII.

THE BLOOD.

1. What is the **Blood**? 79.
2. Of what does the blood consist? 79.
3. Of what per cent by weight are the **Corpuscles** in the blood? 79.
4. Of what per cent by weight is the **Plasma** in the blood? 79.
5. What is the per cent by volume of corpuscles in the blood? 79.
6. What is the per cent by volume of plasma in the blood? 79.

7. What is the specific gravity of the blood? 79.
8. Is the blood alkaline, or acid, in reaction? 79.
9. How many **Red-corpuscles** are there in each cubic millimetre of arterial blood? 79.
10. What is the form and size of red blood-corpuscles? 79.
11. Of what are the red blood-corpuscles composed? 79.
12. When the blood-corpuscles are larger than the capillary vessels, how can they pass through? 79.
13. If water be added to blood, what effect has it on red-corpuscles? 79.
14. What effect have **Strong Alkaline Solutions** on the blood corpuscles? 79.
15. What becomes of blood-corpuscles after they have circulated through the capillaries for some time? 79.
16. In what manner do the **White** blood-corpuscles undergo apparent changes? 79.
17. What is **Hæmoglobin**? 79.
18. What is the per cent of hæmoglobin in red blood-corpuscles? 79.
19. In **What Organs** is the formation of hæmoglobin completed? 80.
20. Of what **Chemical Elements** is hæmoglobin normally composed? 80.
21. What two compounds are included in the composition of hæmoglobin? 80.
22. Where is the composition of hæmoglobin changed from normal in the circulation? 80.
23. Of what composition is hæmoglobin after its circulation through the capillaries of the tissues? 80.
24. Where does the **Color** of hæmoglobin become changed? 80.
25. By what is the oxygen **Absorbed** in the lungs? 80.
26. On what depends the bright **Red Color** of blood-corpuscles? 80.
27. What imparts the reddish color to muscular tissue? 80.
28. What is the principal **Function** of red blood-corpuscles? 80.
29. In what condition do the red blood-corpuscles hold oxygen? 80.
30. What is the difference in regard to vital functions between one class of animals in which the red blood-corpuscles are **Large** but not numerous, and another class in which the red blood-corpuscles are **Small** but more numerous? 80.
31. After the red blood-corpuscles are broken up, how is their number replenished? 80.
32. Is the red blood-corpuscle provided with a **Nucleus**? 80.
33. Do red blood-corpuscles **Originate From** red corpuscles? 80.
34. What is the **Origin** of the **White Blood-corpuscles** that become red? 80.

35. Are the normal constituents of the blood stationary or only temporarily present? 81.
36. How many parts of **Water** are there in 1000 parts of healthy, normal blood? 81.
37. How many parts of **Solids** are there in 1000 parts of healthy, normal blood? 81.
38. By evaporating the water from 1000 parts of blood, how many parts of the solids are corpuscles? 81.
39. Of what do the 210 parts of the solids in blood consist? 81.
40. When the red corpuscles are in excess in blood, what is the result? 81.
41. When the red corpuscles are deficient in number in blood, what is the result? 81.
42. What is the special function of red blood-corpuscles in the lungs? 81.
43. Why is the blood classified as a **Tissue**? 81.
44. What tissue of the body changes its chemical constituents and replaces its losses most quickly? 81.
45. What is the number of white blood-corpuscles compared with the red? 81.
46. What is the diameter and shape of **White Blood-corpuscles**? 81.
47. What kind of blood-corpuscles contain **Nuclei**? 81.
48. What effect have **Strong Alkaline Solutions** on the white blood-corpuscles? 81.
49. In what manner do the white blood-corpuscles circulate in the blood? 81.
50. How do the white blood-corpuscles act when the blood current is retarded or obstructed? 81.
51. What is the **Origin** of the **White Blood-corpuscles** that become **Red**, and of those that remain **White**? 81.
52. Can all poisons of disease working in the blood be detected? 82.
53. What is **Blood-plasma**? 82.
54. What are the constituent parts in 1000 parts of blood-plasma? 82.
55. What causes the alkalinity of the blood? 82.
56. Why must the blood be alkaline? 82.
57. By what action in the body do the **Carbonic Acid Elements** come into existence? 82.
58. Where is the carbonic acid gas **Secreted** and **Eliminated**? 82.
59. Which are the most nutritious ingredients of blood-plasma? 82.
60. What is the origin of the serum of blood? 82.
61. On what functions do the blood-corpuscles and secreted juices in normal condition depend? 82.

62. How is a so-called **Dyscrasia** of the body produced? 82.
63. By what means are the nutritious substances diffused throughout the tissues? 82.
64. By what means is heat supplied to different parts of the body when lost by exposure? 82.
65. By what means are the waste products conveyed to the organs of exit from the body? 82.
66. Is the velocity of the blood current the same everywhere in the body? 82.
67. What is the velocity of blood in the heart during its systole? 83.
68. What is the velocity of the blood in the descending aorta? 83.
69. What is the velocity of the blood in the carotid arteries, vena cavæ, and radial arteries, respectively? 83.
70. What is the velocity of the blood in the capillary vessels? 83.
71. What is the average velocity of the blood in the arteries? 83.
72. What time is required for the blood to make the entire circuit of the body? 83.
73. When is the amount of blood in the body increased? 83.
74. What is the per centage by weight of blood in the body? 83.
75. In cases of death from hæmorrhage, about how much blood remains in the body? 83.
76. Does each tissue absorb all the nutritious materials from arterial blood as it passes through the tissues? 83.
77. Has venous blood of different organs the same composition? 83.
78. Why is the intermixture of the venous blood in the heart necessary? 83.
79. What kind of poisons may be retained in the blood for years? 83.
80. Do certain poisons in the body affect the same kind of tissues alike and at the same time? 83.
81. What system of the body is generally the first depressed and weakened by impure or bad blood? 83.
82. Which of the nervous tissues of the body is the most delicate and soonest affected by insufficient or faulty nutrition? 83.
83. In what condition is the blood in **Chlorosis**? 83.
84. Is the chlorotic condition in chlorosis due to the disease or decay of the red blood-corpuscles? 83.
85. In what sex and age does chlorosis most frequently occur? 84.
86. What are the symptoms of chlorosis? 84.
87. What disease simulates chlorosis? 84.
88. In what condition is the blood in **Leucocythamplio**? 84.
89. State the difference of conditions of the blood in chlorosis and leucocythamplio? 84.

90. Where does the increased production of white blood-corpuscles take place in leucocythamplio? 84.
91. In what condition is the spleen in leucocythamplio? 84.
92. How is the enlargement of the **Spleen** brought about? 84.
93. What is the effect on lymphatic glands and peritoneal covering during leucocythamplio and swelling of the spleen? 84.
94. In what condition is the blood in **Malarial Disease**? 84.
95. What organs are always enlarged in malarial disease? 84.
96. How is the enlargement of the spleen in malarial disease brought about? 84.
97. On what does the coagulation of blood depend? 85.
98. What is the quantity of fibrin in 1000 parts of blood? 85.
99. What causes blood out of blood-vessels to coagulate? 85.
100. Does fibrin, as such, normally exist in the blood? 85.
101. What are the principal ingredients in the formation of the fibrin of the blood? 85.
102. Why does the venous blood contain less fibrin elements than arterial blood? 85.
103. In what organs do the fibrin elements entirely disappear? 85.
104. What veins contain no fibrin elements? 85.
105. When a congenital deficiency of fibrin elements exists in the blood, what is the consequence after ligating a blood-vessel? 85.
106. If a blood-vessel was properly ligated and secondary hæmorrhage occurred, what would that indicate? 85.
107. What is the consequence of a dyscrasia of insufficient fibrin elements in the blood in regard to even a slight wound or operation? 85.
108. What causes chyle as well as lymph to coagulate? 85.
109. What are the constituents of blood before coagulation? 85.
110. What does the clot contain, and what the serum, after blood has coagulated? 85.
111. How soon after death does the blood generally coagulate, even in the heart and large blood-vessels? 85.
112. What may be the cause of the coagulation of the blood in any part of the body during life? 85.
113. To what extent does the blood coagulate in a blood-vessel when ligated? 85.
114. What becomes of the ligated part of the blood-vessel towards the periphery? 86.
115. How is a partial blood thrombus formed? 86.
116. How may a partial thrombus become a complete one? 86.
117. What is a **Thrombus**? 86.

118. How is a thrombus produced? 86.
 119. What is a conical obstructing thrombus? 86.
 120. Does a thrombus once formed in a vessel, become permanent? 86
 121. On what does the formation of the difference of thrombi, in regard to construction and composition, depend? 86.
 122. If a clot forms in the pulmonary veins, or left side of the heart, where may it pass to? 86.
 123. If a clot forms in the venous system, or right side of the heart, where does it pass to? 87.
 124. What is understood by **Embolism**? 87.
 125. What may be the result of embolism? 87.
 126. What prevents the white blood-corpuscles from accumulating excessively, and from adhering one to another? 87.
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CHAPTER IX.

THE CIRCULATION.

1. In what manner are the **Digested Nutritious Substances** carried into the general circulation? 88.
2. Explain the **Route** by which the venous blood of the stomach, spleen, and intestine, is carried to the right auricle of the heart? 88.
3. Explain the **Route** by which the chyle of the intestine is carried to the left internal jugular vein? 88.
4. By what **Means** is the blood carried from the heart to the skin, and back again to the heart? 88.
5. Of what do the **Arterial Capillaries** consist? 88.
6. Who first described the circulation of the blood? 88.
7. Who first described how the arterial blood passed through the capillaries to the veins? 88.
8. Of what does the **Circulatory Apparatus** consist? 88.
9. What is the **Heart**? 88.
10. What is understood by **Arteries**? 88.
11. What is understood by **Capillaries**? 88.
12. What is understood by **Veins**? 88.
13. What is the structure of the heart? 89.
14. Into how many **Cavities** is the heart divided? 89.
15. Name the four cavities of the heart? 89.
16. What is understood by **Venous**, or **Pulmonary Heart**? 89.
17. What is understood by **Arterial**, or **Systemic Heart**? 89.

18. Where does the blood of the right side of the heart pass to? 89.
19. Where does the blood of the left side of the heart pass to? 89.
20. What is the size and weight of the heart? 89.
21. What holds the heart in position? 89.
22. How many **Orifices** has the heart? 89.
23. How many orifices are there in the auricles of the heart? 89.
24. Where are the **Auriculo-ventricular** orifices? 89.
25. Name all the orifices of the heart? 89.
26. How many orifices of the heart have **Valves**? 89.
27. Name the orifices of the heart provided with valves? 89.
28. Of what use are the valves of the heart? 89.
29. Where is the **Eustachian Valve**? 90.
30. Where is the **Valve of Thebesius**? 90.
31. Where is the **Coronary Valve** situated? 90.
32. Where is the **Tricuspid Valve**? 90.
33. What valve is at the pulmonary artery? 90.
34. Where is the **Mitral Valve**? 90.
35. What valve is at the aortic orifice? 90.
36. At what part of the heart is its wall thickest and strongest? 90.
37. By what means does the heart receive its nourishment? 90.
38. What becomes of the blood of the **Coronary Artery** after having nourished the walls of the heart? 90.
39. What arterial blood has the **Shortest** circulation of any in the body? 90.
40. Describe the **Route** by which the blood passes from the right auricle of the heart to the aorta? 90.
41. What is understood by **Cardiac Pulsation**? 91.
42. Where is the first sound of cardiac pulsation the loudest? 91.
43. Where is the second sound of cardiac pulsation best and most distinctly heard? 91.
44. By what is the first sound of the heart caused? 91.
45. By what is the second or aortic sound of the heart caused? 91.
46. For what length of time is the heart at rest? 91.
47. What is understood by **Diastole**? 91.
48. What is understood by **Systole**? 91.
49. What causes the heart to move in a lateral rotating motion? 91.
50. When is the diameter of the heart increased and its length diminished? 91.
51. What is understood by **Rhythm** of the heart? 91.
52. What is the number of pulsations of the heart per minute in the adult? 91.
53. Where does the **Stimulation** for respiration take place? 91.

54. **What Is** the stimulus for respiration? 91.
55. Where does the **Stimulation** for the heart's action take place? 91
56. **What Is** the stimulus for the heart's action? 91.
57. What is the **Primary** physical or chemical **Stimulus** for the normal action of organs and cells? 92.
58. Are the **Nervous Centres** the primary cause of the normal actions of organs and cells of the body? 92.

Read the forcible arguments in the author's "Physiology, on pages 92, 93, and 94, about the *physical laws* of the human economy, the primary cause of the lungs- and heart-action, the power of producing motion, carbonic acid as a stimulus, the primary cause of normal activities, the true actions of the nervous system, the importance of the nervous system, the missing link of organic life, the reasons why the laws of life are not understood, and why a physiology cannot be truthful if the *vital principle* or *soul* is not considered in the text, or in the teachings.

59. What are the symptoms and effect of **Syncope**? 94.
60. What reflex centres are interfered with in syncope? 94.
61. State the nervous operations in sentimental emotions caused by the soul, and affecting the heart? 94.
62. What is the **Function of Arteries**? 94.
63. How do the branches of the **Aorta** terminate in tissues? 94.
64. Of what are the walls of arteries composed? 94.
65. Name the **Three Coats** of arteries, and what they consist of? 94.
66. What difference exists between the walls of large and small arteries? 95.
67. Of what does the coat of large arteries consist? 95.
68. Of what does the coat of small arteries consist? 95.
69. In regard to structure, of what do the capillaries consist? 95.
70. State the **Two Properties** of arteries that influence the movement of the blood within? 95.
71. What influence has the **Elasticity** of arteries? 95.
72. In what is the **Contractility** of arteries concerned? 95.
73. How is the arterial pulsation produced? 95.
74. State the two forces contributing to the production of arterial pulsation? 95.
75. What effect has age on the arteries? 95.
76. What prevents the backward motion of the blood when the heart dilates? 95.
77. At what part of the circulatory apparatus has the blood the greatest velocity? 95.
78. What is the average velocity of blood in the **Carotid** arteries? 95
79. What is the velocity of blood in **Capillary** vessels? 95.
80. What is the pulse rate of the **Fœtus in Utero**? 96.
81. What is the pulse rate in the **New-born** infant? 96.

82. What is the normal pulse in the child from 1 to 4 years old? 96.
83. What is the normal pulse rate at 15 years of age? 96.
84. What is the normal pulse rate from 25 to 60 years of age? 96.
85. Does a rapid pulse indicate strength, or weakness of the heart? 96.
86. To what height may the pulse rate go in **Hydrocephalus**? 96.
87. What may be the rate of the pulse in **Apoplexy**? 96.
88. What is a **Dicrotic Pulse**? 96.
89. How is a dicrotic pulse produced? 96.
90. In what disease is a dicrotic pulse often noticeable? 96.
91. Does a dicrotic pulse always denote a diseased condition? 96.
92. By what instrument can the pulse be measured? 96.
93. What is the **Function of Veins**? 96.
94. What is the structure of veins? 96.
95. In what does the wall of veins differ from the arterial? 96.
96. In what tissues are there no veins? 96.
97. Where do the capillary veins commence? 96.
98. Into how many sets are the veins divided? 96.
99. What do the deep set of veins generally accompany? 96.
100. By what are the smaller arteries accompanied? 96.
101. What is understood by *venæ comites*? 96.
102. Where do the veins beneath the integument discharge? 96.
103. What forms the superior and inferior **Venæ Cavæ**? 96.
104. Where do the superior and inferior venæ cavæ discharge? 96.
105. What is the function of the arterial portion of the capillary? 96.
106. What is the function of the venous portion of the capillary? 96.
107. What veins act in the capacity of arteries? 96.
108. What veins are supplied with **Valves**? 97.
109. Of what structure are the valves of veins? 97.
110. Name the veins that have no valves? 97.
111. Of what use are the valves of the veins? 97.
112. On what does the flow of blood in veins depend? 97.
113. State **Five Forces** that cause the blood in veins to flow? 97.
114. Where do the veins of the stomach, spleen, pancreas, and intestine discharge their contents? 97.
115. In what manner does the *vena porta* supply the liver? 97.
116. From what blood is the **Bile** secreted? 97.
117. What arterial blood passes through **Two Sets** of capillaries after leaving the aorta and entering the vena cava? 97.
118. What is the rate of the movement of the blood in veins compared with that of arteries? 97.
119. Of what capacity is the entire venous system compared with the arterial? 97.

120. What part of the circulatory apparatus is the most important for nutrition? 97.
121. Through what vessels does the interchange between the blood and tissues take place? 97.
122. What is the average diameter of capillaries? 97.
123. How are the capillaries arranged in the muscular system? 98.
124. How are the capillaries arranged in the skin? 98.
125. How are the capillaries arranged around fat-cells? 98.
126. What change takes place in the walls of arteries before the capillary is formed? 98.
127. What is a **Capillary**? 98.
128. How are the capillary **Plexus** formed? 98.
129. Where are the **Largest** capillaries found? 98.
130. Where are the **Smallest** capillaries found? 98.
131. What is the diameter of the smallest capillaries? 98.
132. Is the inosculation of capillaries the same in each organ and tissue? 98.
133. In what organs are the capillaries most numerous? 98.
134. What is the diameter of the arterial and venous capillaries combined, compared with the parent trunk, *venæ cavæ* or *aorta*? 98.
135. What causes the circulation or blood flow in the capillaries? 98.
136. What stimulus causes the peristaltic action in the alimentary canal? 98.
137. What stimulus causes the peristaltic action of the heart and arteries? 98.
138. What stimulus causes the flow of lymph in lymphatic vessels? 98.
139. What stimulus causes the urine to flow in the uriniferous tubules, and in the ureters? 98.
140. What produces the peristalsis of capillary vessels in all organs and tissues? 99.
141. State four reasons why the heart does not cause capillary circulation? 99.
142. State the causes of capillary action in dead matter, for instance, in a sponge, towel, or piece of sugar? 100.
143. At what time, in activity, or repose, are the organs or glands nourished? 100.
144. Why does the arterial blood not become venous in circulating in a paralyzed tissue, in complete muscular repose, or in complete etherization? 100.
145. Why is the venous blood from each organ or tissue different?
146. Why must all the blood of the body return to the heart within half a minute or, at most, within a minute? 100.

CHAPTER X.

RESPIRATION.

1. What is understood by **Respiration**? 101.
2. How much **Oxygen** is absorbed during each inspiration? 101.
3. For what purpose is the **Trachea** provided with cartilaginous rings? 101.
4. What part of the air passage is termed **Bronchial Tubes**? 101.
5. What is the diameter of a bronchial tube? 101.
6. What part of the air passage is termed **Bronchioli**? 101.
7. Where do the bronchioli terminate? 101.
8. Why is the right lung broader and shorter than the left? 101.
9. What is the weight of each lung? 101.
10. What is the color of the lungs? 101.
11. Why does the lung float when placed in water? 101.
12. When air enters the **Pleural Cavity**, what is the effect on the lung? 101.
13. Of what does the *parenchyma* of the lung consist? 101.
14. Of what are the **Lobules** of the lungs composed? 101.
15. How long can respiration go on in cases of **Pulmonary Tuberculosis**? 101.
16. Of how many great lobes are the aggregated lobules of the lungs formed? 102.
17. What area would all the alveoli or air-cells cover if they were spread on a flat surface? 102.
18. Why are liquids and gases called fluids? 102.
19. Whence are the nerve-fibres of the lungs derived? 102.
20. Whence are the nerve-fibres derived that form the **Phrenic Nerve**? 102.
21. What does the phrenic nerve supply? 103.
22. From what does the phrenic nerve proper arise? 103.
23. By what **Route** does the phrenic nerve descend to the diaphragm? 103.
24. What is the result on respiration if the phrenic nerve alone be divided outside the spine? 103.
25. What is the result on respiration of a division or compression of the intercostal nerves? 103.
26. What is the result on respiration of a division of the spinal cord above the third cervical vertebræ? 103.

27. Why does respiration stop when the **Medulla Oblongata** is injured? 103.
28. Why does a gasping inspiration ensue when cold water is poured on the skin of the chest? 103.
29. Why does a tickling of the soles of the feet, or the skin of the sides of the body, cause laughter? 103.
30. Describe the **Nervous Phenomenon** when a funny sight, or the hearing of a funny speech, produces laughter? 103.
31. Where is the **Respiratory Reflex Centre** (*vital point*)? 103.
32. By what **Route** is the stimulus carried to the reflex centre of respiration? 103.
33. By what **Route** are the motor impulses carried to the lungs and respiratory muscles? 103.
34. What is the office of the lymphatics of the lungs? 103.
35. By what kinds of blood are the lungs supplied? 103.
36. For what purposes do the two kinds of blood enter the lungs? 103.
37. Through what channel is the arterial blood derived for the **Nourishment** of the lungs? 104.
38. Through what channel is the blood of the lungs derived for its **Purification**? 104.
39. What becomes of the blood of the bronchial artery? 104.
40. What becomes of the blood of the pulmonary artery? 104.
41. Whence does the pulmonary artery convey the blood? 104.
42. How are the **Capillaries** of the pulmonary artery arranged in the alveoli? 104.
43. Of what thickness is the **Capillary Wall** at the alveoli? 104.
44. What is the diameter of the pulmonary capillary at the wall of the alveoli? 104.
45. What is the diameter of an **Alveolus**? 104.
46. By what are the alveoli separated? 104.
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48. How many alveoli are in the lungs of an adult? 104.
49. By what kind of cells are the walls of the alveoli lined? 104.
50. What is contained in the walls of the alveoli? 104.
51. Is each pulmonary capillary in contact with one alveoli only? 104.
52. How long is the blood in the capillaries exposed to the air in the alveoli? 105.
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54. What substance of the blood attracts the oxygen? 105.
55. By what forces is the absorption of oxygen and the liberation of carbonic acid gas in the alveoli accomplished? 105.

56. Why is respiration more difficult and hurried in an atmosphere of higher temperature than blood? 105.
57. What benefit is there in perspiring when living in a high temperature? 105.
58. Why is the *Venous Blood* carried to the lungs by an artery? 105.
59. Why is the *Arterial Blood* of the lungs carried away by veins? 105.
60. How many vessels carry the aerated blood of the lungs to the heart? 105.
61. Where is the arterial blood converted into venous? 105.
62. What is the **Stimulus** for respiration? 105.
63. What **Counteracts** the normal carbonic acid stimulation of the lungs? 105.
64. In what manner do the nervous centres act on organs? 105.
65. How are the nervous centres connected with organs? 105.
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67. Where is the **Respiratory Reflex Centre** situated? 106.
68. Where is **Hæmoglobin** completely formed? 106.
69. To what is hæmoglobin allied? 106.
70. Of what is hæmoglobin composed? 106.
71. On what does the absorption of oxygen in the lungs depend? 106.
72. What is the result when iron is deficient in blood? 106.
73. What do the red blood-corpuscles give up to the tissue? 106.
74. What becomes of the red blood-corpuscles after they have given up the oxygen, iron, hæmoglobin, and potassium salts? 106.
75. Do the corpuscles, or the plasma, of the blood carry the carbonic acid elements? 106.
76. What becomes of hæmoglobin entering the liver? 106.
77. From what is **Hæmatin** derived? 106.
78. What causes the lungs, glottis, chest, and abdominal movements to act so harmoniously together? 106.
79. What **Amount of Air** is renewed at each inspiration? 106.
80. State the number of respirations at different ages? 106.
81. What produces the *crepitus*, or *vesicular murmur* of the lungs? 106.
82. What influence has the **Will** over respiration? 107.
83. Why can a person remain under water for a short time only? 107.
84. On what do the expansive and collapsing forces of the lungs depend? 107.
85. What is the action of the **Diaphragm** and **Intercostal Muscles** during inspiration? 107.
86. What effect has an injury in the lower cervical or upper dorsal region of the spinal cord on respiration? 107.

87. What is the effect of peritonitis or abdominal inflammation on respiration? 107.
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90. How much air does an adult require in 24 hours? 107.
91. What is the result if inhaled air contains less than 10 per cent of oxygen? 107.
92. State why death results when insufficient oxygen is contained in inhaled air? 107.
93. What causes the **Convulsive Movements** before death from **Asphyxia**? 108.
94. What is the **Composition** of normal **Inspired** air? 108.
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97. What precaution is required when the pleural cavity has to be opened? 108.
98. How much water is eliminated by the lungs of an adult in 24 hours? 108.
99. Why does a person with a dry and hot skin **Respire** more frequently? 108.
100. Why does respiration become less frequent during and after thorough **Perspiration**? 108.
101. Why does a dog protrude its tongue during hot weather or while running very fast? 108.
102. What substances are given off by the lungs and skin? 108.
103. Why is the air oppressive in a crowded and confined space? 108.
104. Under what form do carbonic acid elements exist in the economy? 108.
105. Does *carbonic acid gas*, **As Such**, exist in the blood? 108.
106. Where is the carbonic acid **Gas** produced in the body? 108.
107. By what is the carbonic acid **Gas** of the lungs, skin, and kidneys produced? 109.
108. What is the formula of carbonic acid? 109.
109. Of what does the gas issuing normally from the body consist? 109

In regard to the formation of carbonic acid gas, animal vitality, primary stimulus for respiration, actions on lungs and heart, external organic sensation, motion of blood in capillaries, paramagnetic action of oxygen, diamagnetic action of carbonic acid, mixture of oxygen and carbonic acid gases in the lungs, respiratory activity, why respiration and pulsation act in unison, carbonic acid gas from

the skin, continual activity of the skin, amount of carbonic acid from lungs skin and kidneys, cause of organs that are continually active, most vital importance of carbonic acid in the body, respiratory excitants, action of albumen on respiration, increased perspiration, increased urine secretion, irritability of organs and tissues, organs where oxygen enters, organs of exit of carbonic acid, origin of heat in the body, cause of high temperature in disease, true physiological process in lowering high temperature, how medicines act in lowering high temperature, cause of the periodical rise of temperature, why oxidation is a misnomer, why combustion in the body is a misnomer, **how untruths are taught to students**, metabolic processes of cells and tissues, importance of oxygen in the vital economy, paralysis from oxygen, elements of compound proteids, physiological importance of sulphur, physiological importance of iron, transformation of albumen into tissues, formation of carbonic acid in different ages, why some animals can remain in water as well as on land, causes of dyspnœa, how to promote respiration in the newly-born infant, or to overcome asphyxia—for all of the foregoing read the text on Respiration in Schmitz's "Physiology," page 108 to the end of the chapter page 117.

CHAPTER XI.

TEMPERATURE.

1. How is the vital or **Animal Heat** produced? 118.
2. Why does the temperature vary in each organ and tissue? 118.
3. Define **Heat**? 118.
4. Why does heat expand all kinds of matter, whether *solid, liquid, or gaseous*? 118.
5. Under what condition does a liquid dissolve a solid? 119.
6. Why does the blood, in high temperature of the body, dissolve the more solid tissues? 119.
7. How is the normal, regular standard of temperature of the body maintained, be it summer, or winter? 119.
8. What parts of the body possess the equalizing power of temperature? 119.
9. Is absolute rest possible in nature? 119.
10. Why are the deeper tissues of the body warmer than the more superficial? 119.
11. How is the temperature of the body affected immediately after meals? 119.

12. How is the temperature of the body affected during digestion and absorption? 119.
13. What effect on the blood and temperature has section of the sympathetic nerve supplying a part? 119.
14. Why is the temperature of arterial blood the same, while that of venous blood varies in each organ and tissue? 119.
15. Name two cold liquids that evolve heat immediately upon mixing? 120.
16. By what medium are the materials for the renewal of normal heat, carried? 120.
17. What degree of difference is there in the temperature of the blood in the left and right auricles of the heart? 120.
18. In what organ of the body is the temperature highest? 120.
19. Why is the temperature of the hepatic veins the highest of the body? 120.
20. At what part of the body is the temperature the lowest? 120.
21. Why is the temperature of the peripheral capillaries lowest? 120.
22. What degree of internal high temperature generally proves fatal to the body? 120.
23. To what degree of high atmospheric temperature can a person live? 120.
24. What is a **Caloric**? 120.
25. Has **Temperature** reference to the quantity of heat? 120.
26. What is the normal temperature of an adult? 120.
27. At what time during the 24 hours is the normal temperature of the body highest; at what time lowest? 120.
28. What is the temperature at birth, and how does it vary between birth and the age of 50? 120.
29. Change the temperature of 97° F. into Centigrade? 120.
30. Change the temperature of 37° C. into Fahrenheit? 121.
31. When exposed to cold, how can the normal temperature of the body be increased or maintained? 121.
32. What does a persistent abnormal temperature indicate? 121.
33. In what fatal disease does the temperature remain normal? 121.
34. Why is temperature intimately connected with the functions of vitality? 121.
35. Why are the vital activities, such as nutrition, growth, reproduction, possible only within certain limits of temperature? 121.
36. What are the extreme limits of internal human temperature? 121
37. Why does a persistent abnormal high temperature prove fatal? 121
38. What relation exists between the temperature and the pulse? 121
39. What pulse-rise for every degree of temperature above 100° F.? 121

40. Why should the temperature be taken soon on visiting a patient? 121.
41. If an increased pulse is due to disease, what is the temperature?
42. Can external indications be relied upon in regard to internal temperature? 121.
43. How should the temperature of the body be taken? 122.
44. What causes the temperature of the body to rise in old age? 122.
45. What does a persistent increase of temperature of the body without exhibiting any disease, indicate? 122.
46. What does an increase of temperature during tuberculosis, indicate? 122.
47. What is indicated if the temperature does not rise above 102° F. in **Pneumonia**? 122.
48. What does a persistent temperature of 104° F., or more, in pneumonia, indicate? 122.
49. What does a temperature of 104° F. in **Acute Rheumatism**, indicate? 122.
50. How long is the temperature high in **Exanthematous** diseases? 122.
51. What produces the high temperature in **Tetanus**? 122.
52. What does an increase of temperature above the normal in **Jaundice**, indicate? 122.
53. What does a normal temperature in **Kidney Disease**, indicate? 122.
54. What does an internal temperature and pulse **Below Normal** indicate? 123.
55. How does **Bile** in blood act to lower the temperature and pulse-rate? 122.
56. Give some local affections that cause an abnormal low pulse? 122
57. What effect has intestinal hæmorrhage on the pulse? 123.
58. What degree of temperature of the body is considered as fever? 123
59. What disease is a person apparently well likely to have, when there is a sudden rise of temperature from 101° to 105° F.? 123
60. What are the manifestations of temperature in typhoid fever? 123
61. At what time in the 24 hours in the temperature normally highest, at what time lowest? 123.
62. What does a higher temperature in the forenoon than on the previous afternoon in typhoid fever, indicate? 123.
63. What results from a persistent internal temperature of 107° F. or more? 123.
64. What does a sudden rise of temperature to about 105° or 107° F., or a sudden fall below normal, indicate? 123.

65. What is the **Most Direct** and **Simple Means** of moderating high temperature of the body? 123.
 66. How much water is daily discharged from the body? 123.
 67. How much water is given off by the skin in 24 hours? 123.
 68. How much water is given off by the lungs in 24 hours? 123.
 69. How much heat is normally evaporated from the body in 24 hours? 123.
 70. How is heat given off by the growing plant? 123.
 71. At what time is the production of heat in plants increased? 123
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CHAPTER XII.

THE NERVOUS SYSTEM.

1. Give the structure of the **Nervous System**? 124.
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3. State where the gray nervous substance is found? 124.
4. What constitutes a **Nervous Centre**? 124.
5. Of what is the **White** substance of the brain and spinal cord composed? 124.
6. Where is the white nervous substance in the brain and spinal cord, found? 124.
7. Name the **Two Great Divisions** of the nervous system? 124.
8. Of what does the **Cerebro-spinal System** consist? 124.
9. What is the function of the cerebro-spinal system? 124.
10. To what parts of the body are the nerve-fibres of the cerebro-spinal system principally expended? 124.
11. To what do the involuntary muscles and muscular fibres owe their contraction? 124.
12. To what is the contraction of the bladder, stomach, and intestines, due? 124.
13. What is understood by mixed muscles? 125.
14. What is the **Function** of the nervous system? 125.
15. By what is the relationship of function (*sympathy*) of the nervous system, accomplished? 125.
16. Give two illustrations of sympathy of one organ to another through physical impressions? 125.
17. Give three illustrations of sympathy of physiological actions on organs? 125.
18. Give an illustration of sympathy through mental excitement? 125.
19. What is understood by the **Encephalon**? 125.

20. Name the four divisions of the brain? 125.
21. How are the brain centres and spinal cord connected? 125.
22. Into how many parts does the longitudinal fissure divide the brain? 125.
23. How are the principal brain centres connected? 125.
24. How are the cerebral areas (*centres*) connected with the sympathetic ganglia? 125.
25. Where is the **Greatest Quantity** of the **Gray** substance of the brain, found? 126.
26. What fissures or grooves of the brain are similar in all human individuals? 126.
27. Into how many lobes is each cerebral hemisphere divided? 126.
28. Of what does the **Corpus Callosum** consist? 126.
29. How are the **Two Hemispheres** of the brain connected? 126.
30. Of what does the corpus callosum form the roof? 126.
31. Where is the fifth ventricle? 126.
32. Where is the third ventricle? 126.
33. Where is the fourth ventricle? 126.
34. What is the chemical **Composition** of the healthy adult brain?
35. What chemical substance has been found deficient in **Insane Brain**? 127.
36. What arteries supply the brain with blood? 127.
37. What forms the **Circle of Willis**? 127.
38. In the arrangement of the circle of Willis, its work and importance, can we not see that the wisdom of the Creator only, could design such a structure? 127.
39. If the circulation of the brain be interfered with, tho, only for a moment, what is the result? 127.
40. Where must the hæmorrhage be in a case of coma from hæmorrhage of the brain? 127.
41. Where must the hæmorrhage happen in case of hemiplegia from hæmorrhage of the brain? 127.
42. What is the result on the body in galvanization of the dura mater on one side of the head? 127.
43. What is the result on the body in galvanization of the cerebral convolutions on one side of the brain? 127.
44. Why does galvanization on one side of the cerebral convolutions excite muscular action on the *opposite* side of the body? 127.
45. Are the gray and white substances of the brain excitable under ordinary artificial stimulus? 127.
46. Which is the largest of the four divisions of the brain? 127.
47. What is the form of the upper surface of the cerebrum? 127.

48. What condition of the convolutions of the cerebrum bears on the intellectual power of the individual? 128.
49. How are the cerebral convolutions of the lower animals distinguished from those of man? 128.
50. Of what does the exterior of the cerebrum consist? 128.
51. Of what does the interior of the cerebrum consist? 128.
52. Name the nervous centres belonging to the cerebrum? 128.
53. Into how many lobes is each hemisphere of the cerebrum divided? 128.
54. Where is the **Olfactory Lobe** situated? 128.
55. Through what cells of nervous centers does the **Intellect** of man operate? 128.
56. What nervous structure is required for an **External Sensation**? 128.

(We have now come in the text in Schmitz's "Physiology," page 129, to the "**Operations of the Intellect and Imagination.**" In answer to a question by a student of the class of 1896, for more information on these subjects, the reader is referred to the end of this chapter, see page 55 of this book.)

57. Is the cerebrum directly essential for the immediate continuation of life? 129.
58. Why may life continue for a time, even if the cerebrum is seriously injured? 129.
59. What is the result of a lesion of the cerebral convolutions affecting the gray substance, or an impairment of its functions? 129.
60. What is **Reason**? 129.
61. What is **Judgment**? 129.
62. Define **Insanity**? 129.
63. Name the different forms of insanity? 129.
64. Can a physical lesion of the brain always be detected in case of insanity? 129.
65. Define the **Soul**? 129.
66. Where are the **Corpora Striata** situated? 130.
67. Why are the corpora striata so termed? 130.
68. Of what do the corpora striata consist? 130.
69. What forms the **Nucleus Caudatus**? 130.
70. What forms the **Neucleus Lenticularis**? 130.
71. Where is the **Claustrum** situated? 130.
72. What kind of nerve-fibres proceed to the corpora striata? 130.
73. What is the **Function** of the corpora striata? 130.
74. What cerebral centre communicates with the voluntary muscles?

75. If the corpora striata on one side of the brain be injured, what is the result? 130.
76. What may be the result of the impairment of both corpora striata? 130.
77. Where are the **Optic Thalami** situated? 130.
78. Of what do the optic thalami consist? 130.
79. What kind of nerve-fibres proceed to the optic thalami? 131.
80. What is the function of the optic thalami? 131.
81. What is the result if the optic thalamus of one hemisphere is destroyed? 131.
82. What constitutes the **Basal Ganglia**? 131.
83. Of what do the **Corpora Quadrigemina** consist? 131.
84. Where are the corpora quadrigemina situated? 131.
85. What is the structure of the corpora quadrigemina? 131.
86. What is the function of the corpora quadrigemina? 131.
87. What is the result if the function of the corpora quadrigemina of one hemisphere be impaired? 131.
88. What is the result of simple irritation of the corpora quadrigemina? 131.
89. What effect has the impairment of the corpora quadrigemina on the body? 131.
90. Where is the **Pineal Gland** situated? 131.
91. What is the function of the pineal glands? 131.
92. What is the structure of the **Crura Cerebri**? 131.
93. What is the dark-gray matter in the crura cerebri termed? 131.
94. What nerve-fibres originate in the *locus niger* of the crura cerebri? 132.
95. What is the posterior portion of the crura cerebri termed? 132.
96. Through what part of the crura cerebri do the **Sensory** fibres pass? 132.
97. Through what part of the crura cerebri do the **Motor** fibres pass? 132.
98. Give the path of the spinal sensory fibres to the cerebral convolution? 132.
99. Give the path of the motor fibres from the cerebral convolutions to the spinal cord? 132.
100. Where is the **Valve of Vieussens** situated? 132.
101. What nerve originates at the side of the valve of Vieussens? 132.
102. State the relation of position of the four divisions of the brain?
103. Of what does the **Pons Varolii** consist? 132.
104. What divides the pons Varolii into two halves? 132.
105. What nerves contain fibres arising in the pons Varolii? 132.

106. Where is the **Cerebellum** situated? 132.
107. What separates the cerebellum from the cerebrum? 132.
108. What divides the cerebellum into two halves? 132.
109. Of what does the cerebellum consist? 132.
110. What is the difference of structure of the convolutions of the cerebellum, and those of the cerebrum? 132.
111. Where is the **Corpus Dentatum** situated? 133.
112. How does the cerebellum communicate with the spinal cord? 133.
113. State the origin of the nerve-fibres that enable us to maintain the head in proper position on the trunk of the body? 133.
114. What is the function of the cerebellum? 133.
115. What effect has a lesion of the gray substance of the cerebellum on the muscles and limbs of the body? 133.
116. Is the cerebellum the centre governing sexualism? 133.
117. What is often the cause of the constant agitation of the head, limbs, or of both? 133.
118. What is understood by **Æsthesia**? 278.
119. What is understood by **Agglutination**? 278.
120. What is understood by **Algesia**? 278.
121. What is **Amentia**? 279.
122. What is **Anabolism**? 279.
123. What is **Analgesia**? 280.
124. What is **Aphasia**? 280.
125. What is **Aphonia**? 280.
126. What is understood by **Callosus**? 282.
127. What is **Dementia**? 285.
128. What is a **Gyrus**? 289.
129. What is understood by **Gyrus Fornicatus**? 289.
130. What is **Hemianæsthesia**? 289.
131. What is **Hemiplegia**? 289.
132. What is **Hyperæsthesia**? 290.
133. What is **Hyperplasia**? 290.
134. What is **Inanition**? 291.
135. What is **Kinetic Energy**? 291.
136. What is understood by **Limbic Lobe**? 292.
137. What is **Monomania**? 294.
138. What is understood by **Nervous**? 295.
139. What is understood by **Pathetic**? 295.
140. What is understood by **Pituitary**? 296.
141. What does **Psychical** refer to? 297.
142. What is **Psychical Blindness**? 297.
143. What is understood by **Sphacelus**? 300.

INTELLECT AND IMAGINATION.

GOD, AND SOUL.

The following is the answer of the author to the question referred to above, on page 53, as delivered in a lecture to the students of the class of 1896, in regard to the "**Operations of the Intellect and Imagination.**"

Everything that may be performed, made, or done by man, must, first of all, have made an impression on either one or more of the external five senses. A man deprived of all of these senses, can accomplish nothing, he is, to all intents and purposes, dead.

In regard to immaterial things, the soul (mind), *while in our body*, can accomplish nothing without first imagining the subject *in a material form*. Illustrated: Can anyone think of an angel (the thought of which is surely an act of the intellect only), without imagining that the angel is in the form for example, of a child or human being with wings? Yet, the angel is an immaterial being, and consequently, has no body or wings. Again, can anyone think of God, without imagining Him for example in the shape of a great powerful man or under some other corporeal form? Yet, He has no body; but is an inspiritly intelligent, Spiritual Being, as every one endowed with reason must admit for all that we see about us teaches and proclaims that nature is governed by exact and precise laws, from which the only logical conclusion is the existence of an All-wise Law-giver and Governor distinct and above matter. Let us notice again in this connection, that the operations of the intellect cannot act, "unless the operation of the imagination, which, depends primarily on the external senses, precedes and accompanies it." Imagination is an issue-product between the spiritual soul and the animal material body.

Now, I have mentioned a God, and a soul. Some of you may possibly say: What have we to do with such remarks in a physiological medical lecture? Let me tell you, sincerely, that we cannot dispense with them, if we want to be honest and truthful to you. Every one of you certainly wishes to be a scientifically trained physician, and to know all about the laws governing both mind and body and their dependence on the *First Primary Cause*. Who has ever explained thought and reason truthfully and fully by studying simply the material world about him and resting in the mere material? Every man has a longing, more or less intense, to probe things to their ultimate causes; and man by denying God and the soul, has nothing to build on. Can such a man find and state the truth? No, he is like one tossed about on the wide ocean, in a boat without a rudder, seeking the harbor he shall never attain. Every scientific subject demands sufficient truthful explanation, if any.

Again, as scientific men, we are not even satisfied to know merely the material and spiritual part of man, but, as a historical fact, we want to know the origin of man also. For that reason, while I am at it, I will use the rest of the time allotted to our lecture to-day on this subject.

Through what organs or parts, the vital principle (soul, mind) stimulates in causing the various actions of the body, has previously in different lectures been illustrated to you on the black-board, and, as far as I know, to your comprehension and entire satisfaction. So we need not dwell any more on that part.

The materialist denies spiritual existence; but, I would ask him to explain on material grounds, how the thought of a dead animal on the street, can

make a person's (material) stomach throw up its contents? He cannot explain. I would ask him to explain how in the material body, or out of material food, reason and judgment come into existence? He cannot explain. Ask him to explain on material grounds, how the sensations of sorrow and happiness come into existence? He cannot explain those either. Now, if I had taught you physiology (the laws of life) on material grounds only, would it not have been a parody on science, and a proof of consummate ignorance and falsehood?

We have all read, or heard it stated that: "*The fool has said in his heart there is no God.*" Now, pure scientific inquiry into the laws of nature, and human physiology, would furnish a proof, if such a proof were wanting of the truth of this statement, and men who deny it are like beggars with sound eyes who carry written on their foreheads: "I am blind." By observation on the scientific absolute materialist, we find also, that his purpose is never wanting, be that egotism, money-making or public notoriety. The materialist is ever superficial, and a perverter of science; don't forget that. True science teaches and elevates, nonsense lowers to the animal. The true scientist is always a God-loving man.

Sound reason leads to the conclusion that, what does not exist cannot produce activity or bring forth itself, and, as the world has all the marks of a contingent being, it must have been created. We know positively that no created action is possible without a cause, and consequently we are forced in the ultimate analysis and come to the existence of a God. Again, in regard to the laws of nature, we comprehend that, no law can possibly be thought of without a law-maker who existed before the law. God was, is, and always will be active in His Creation, and, were He to withdraw His concurrence for an instant, the whole material world would cease to be and fall back into its pristine nothingness.

Of all the spurious materialistic explanations of the origin of the world, that have occasionally been brought forth, not one has stood the test. We are bound, therefore, to fall back and adhere to the one true explanation set forth by Moses in the first chapter of *Genesis*: This God-inspired writer was the first who wrote of God's creation and there most wonderfully does he describe the difference of the creation of man, and that of the animals and plants.

The kind attention and great interest you seem to take in these remarks, encourages me to proceed.—After the creation of heaven and earth, of the sun, stars, the planets, of light and darkness, God said: "All is well." Then He created the plants of the earth, and they lived; then the animals, and the fishes of the waters, and said: "Increase and multiply." Here, let us remark that, the creation of the body and vital principle of the plants, fishes, and animals, in each case, was **One Act** only. This goes to show that their bodies and souls are inseparable and dependent, and that when the body of the plant, fish, and animal dies, its vital part (soul) also ceases to be.

Now, notice the difference; then He formed the body of man from the earth, and breathed into him the breath of life. In man, therefore, God formed the material part first, and afterward imparted to him by a special creative act the principle of a living soul. The creation of the body and soul consequently, of man, required **Two Acts**. While he lives, that body and soul makes up one composite being, but after death, the soul, because independent of the body, can still live and does and will live forever in accordance with the yearning for immortality which the Author of Life has implanted in the soul. The act and manner of creation of the soul of man, teaches us also, that the spirit is a simple thing which needs no further development, and can exist in a body or without one after death. The soul of the plant, the soul of the animal, and the soul of man, are three entirely different things, and bear to

one another this only relation, that they have all been produced by *One Almighty, Creator*.

We can see the wisdom and greatness of the Creator everywhere, yet we do not need to go outside of our own body to prove the existence of God, and the presence of an immaterial soul. This I will explain to you now on the black-board. In anatomical and physiological investigations, we have found that the **Material Human Body** consists of, and depends on, **Systems** and **Apparatus**, (see next page). We found that the two latter consist of, and depend on, **Organs**; these on **Cells**; these on **Nuclei**; these on **Nucleoli**; these on **Molecules**; these on **Atoms**. Now, no chemist or scientist has ever penetrated further than the Atom. We find that of all these material structures, one thing depends on another, except the Atom. The question then arises, **Is the Atom Independent?** The answer to this will follow hereafter; for the present we simply make a question-mark—?—below the Atom.

Since with few exceptions, as you all know the fruit is carried on the top of the tree or plant, so we will delineate and describe the fruit or qualities of the human body, as over or above the body. We write then above the body, that it manifests **Vitality** (see the next page), which is essential for **Senses**, through which are effected **Impressions**, that lead to **Reason**, resulting in **Conclusion** (*Judgment*); which requires a **Mind** or **Soul**. Here again, you notice that we have come to the end and we place the interrogation mark—?—as before. The question here is indeed similar: **Is the Soul an Independent Finality.**

We have considered the Human Body, as the Greeks say from "*Alpha to Omega*," and, in conclusion, I am sure that all right-minded men will admit with me, reasoning from the very contingency which everything about us bears, that the **Atom** and the **Soul** depend on a necessary, immutable, self-existing *Being*, we call **God**.

?

SOUL
OR
MIND

REQUIRES A
(JUDGMENT)
CONCLUSION

RESULTS IN

REASON

LEAD TO

IMPRESSIONS

EFFECT

SENSES

ESSENTIAL FOR

VITALITY

MANIFESTS

HUMAN BODY

CONSISTS OF AND DEPENDS ON

SYSTEMS AND APPARATUS

THESE ON

ORGANS

THESE ON

CELLS

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NUCLEI

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NUCLEOLI

THESE ON

MOLECULES

THESE ON

ATOMS

THESE ON

?

READ UPWARD

READ UPWARD

READ DOWNWARD

READ DOWNWARD

CHAPTER XIII.

THE MEDULLA OBLONGATA.

1. Where is the **Medulla Oblongata** situated? 134.
2. By what is the medulla oblongata subdivided? 134.
3. Name the four columns of the medulla oblongata? 134.
4. Of what is the anterior pyramid of the medulla oblongata a continuation? 134.
5. Of what is the lateral tract of the medulla oblongata a continuation? 134.
6. Of what is the restiform body of the medulla oblongata a continuation? 134.
7. Of what is the posterior pyramid of the medulla oblongata a continuation? 134.
8. Where is the **Olivary Body** situated? 134.
9. What nerves carry fibres arising at the olivary body? 134.
10. By what is the **Fourth Ventricle** formed? 134.
11. What forms the floor and roof of the fourth ventricle? 134.
12. With what does the fourth ventricle communicate upward? 134.
13. At what part of the medulla oblongata do the cerebro-spinal nerve-fibres decussate? 134.
14. What portion of the brain is the **Most Important** for the immediate continuation of life? 135.
15. Where are the **Reflex Centres** situated presiding over **Respiration** and **Circulation**? 135.
16. How many **Cranial Nerves** contain fibres originating in the medulla oblongata? 135.
17. What cranial nerves contain no fibres from the medulla oblongata? 135.
18. Over what functions do the reflex centres of the medulla oblongata preside? 135.
19. Name the external sense organs that are connected with some nerve-fibres with the medulla oblongata? 135.
20. Where is the **Vaso-motor** reflex centre situated? 135.
21. Where is the reflex centre for co-ordinate movements of the palate, pharynx, and œsophagus, for **Deglutition** and **Swallowing**? 135.

22. Where is the reflex centre for co-ordinate movements concerned in **Speech**? 135.
23. Where is the **Salivary Excitor** reflex centre? 135.
24. Where is the **Cardio-inhibitory** reflex centre? 135.
25. Why does irritation of the medulla oblongata cause glycosuria or **Diabetes Mellitus**? 136.
26. What does the blood supply to the medulla oblongata? 136.
27. Why does a **High Temperature** cause acceleration of the heart and lungs? 136.
28. When do the **Vaso-motor** and **Respiratory** reflex centres, respectively, commence to be stimulated? 136.
29. At what spot of the medulla oblongata is the **Respiratory Reflex Centre** situated? 136.
30. Of what does the **Vital Point** consist? 136.
31. Whence is the stimulation for the respiratory reflex centre derived? 136.
32. What influence has **Inhaled Oxygen** on respiration? 136.
33. What is the result if the lungs are over-saturated with carbonic acid, or with oxygen? 136.
34. What does respiratory irregularity in disease, indicate? 136.
35. On what does **Respiratory Irregularity**, depend? 136.
36. Does suspension of **Volition, Sensation, and Intellectual Power**, necessarily prove fatal? 136.
37. Does cerebral **Apoplexy** from hæmorrhage necessarily prove fatal? 136.
38. At what part of the brain does hæmorrhage produce immediate **Death**? 136.
39. Where is the reflex centre for **Deglutition**? 137.
40. At what part of the mouth and throat is swallowing voluntary, and at what part involuntary? 137.
41. When the swallowing of **Food** or **Drink**, during disease produces choking, though the throat is clear, what does that indicate? 137.
42. What brain centres require to co-operate in the exercise of the **Voice** or exhibition of **Emotion**? 137.
43. Where does the **Hypoglossal Nerve** originate? 137.
44. Where is the reflex centre for the mechanism in the larynx in the production of sound, situated? 137.
45. What nerve carries the motor impulses to the muscles of the **Tongue** and regulation of the **Rima Glottis**? 137.
46. Where is the seat of lesion in difficult articulation, **Paralysis of the Speech** muscles, or of **Ataxic Aphasia**? 137.

CHAPTER XIV.

NERVOUS CENTRES AND REFLEX ACTION.

1. What is a collection of gray matter of the nervous system termed? 138.
2. Of what is a **Nervous Centre** composed? 138.
3. Does a mass of gray nervous matter contain only one nervous centre? 138.
4. What is the function of nervous centres? 138.
5. Of what do the nervous centre **Cells** consist? 138.
6. What is the size of nervous centre cells? 138.
7. Where are the largest nervous centre cells found? 138.
8. Where are the smallest nervous centre cells found? 138.
9. Where are the middle-sized nervous centre cells found? 138.
10. How are the nerve-fibrillæ connected with cerebro-spinal nervous centre cells? 138.
11. Have all nervous centre cells an equal number of **Processes**? 138.
12. What portion of the nerve-fibre is in communication with the nucleolus of the nervous centre cell? 138.
13. Name the four classes of **Peripheral Termination Cells**? 138.
14. What is understood by *axis cylinder process*? 138.
15. In how many **Classes of Functions** are the different nervous centres concerned? 139.
16. How many classes of nervous centre functions are involved in the **External Senses**? 139.
17. How many classes of nervous centre functions are involved in the **Internal Senses**? 139.
18. What are the **Five** external senses? 139.
19. What are the **Four** internal senses? 139.
20. What causes the nervous centre cells to act? 139.
21. When the nervous centre cells have received an impulse, what then is their action? 139.
22. Give an illustration of nervous centre cells that are constantly active? 139.
23. Why do convulsive actions of the body occur easier during sleep, than when awake? 139.
24. How can **Convulsions of Children** often be prevented? 139.
25. How are the reflex excitabilities increased? 139.
26. How can reflex excitabilities be diminished? 139.

27. In what organs do the **Reflexes** take place? 139.
28. What is understood by **Reflex Action**? 139.
29. Is the energy of a stimulus **Transformed** in a sense-organ, or how is the organ stimulated? 139.
30. What is **Sensation**? 139.
31. Physiologically, what is **Property**? 139.
32. Physiologically, what is **Irritability**? 140.
33. Physiologically, what is **Excitability**? 140.
34. How many varieties of stimulation can excite living matter? 140
35. Name the **Five Varieties** of stimulation which excite living matter? 140.
36. How does heat or cold act in regard to the excitability of living matter? 140.
37. When a nerve or muscle is at absolute rest for a long time, what is the result? 140.
38. What is understood by **Co-ordination** of reflex action? 140.
39. How many agents are required for a **Voluntary**, or **Involuntary** external activity? 140.
40. Name **Seven Agents** required for a reflex act? 140.
41. By what are the nervous centres in communication with each other? 140.
42. Of what is the medullary or **White Nervous Substance** of the brain and spinal cord, composed? 140.
43. In how many ways can co-ordinate movements and reflex acts of the body be produced? 140.
44. Name the three ways by which co-ordinate movements and reflex acts may be effected in the body? 140.
45. To what are the normal activities of organs and performance of functions due? 141.
46. Give an illustration of how activities of organs and performance of functions are produced by reflex action? 141.
47. To what is the disturbance of equilibrium of other organs due, when one organ of the body is disturbed? 141.
48. Give an illustration of disturbance of equilibrium caused by one organ on another? 141.
49. Why does not the entire system generally suffer severely, when the action of one organ is abnormally increased? 141.
50. What action may the will exercise over certain reflexes? 141.
51. Give an illustration of external reflexes on organs in response to stimulation of the skin? 142.
52. What is understood by **Pupil Reflex** from irritation of the skin? 142.

CHAPTER XV.

NERVE FIBRES AND THEIR TERMINALS.

1. What is a **Nerve-fibre**? 143.
2. Of what is a nerve-fibre composed? 143.
3. What is the structure and function of the nerve-fibre **Sheath**?
4. What is the medullary layer of nerve-fibres termed? 143.
5. Of what is the **White Substance of Schwann** composed? 143
6. What is the physiological property of the white substance of Schwann? 143.
7. What is the structure of the **Axis Cylinder**? 143.
8. Where is the axis cylinder situated? 143.
9. What is the physiological property of the axis cylinder? 143.
10. What is the average diameter of nerve-fibres? 143.
11. Where are the smallest nerve-fibres found? 143.
12. Where are the largest nerve-fibres found? 143.
13. In structure how do nerve-fibres differ? 143.
14. Are nerve-fibres medullated throughout their entire length? 143
15. What is understood by **Neurilemma**? 143.
16. What is the origin of the neurilemma? 143.
17. What is a **Nerve**? 143.
18. Do nerve-fibres within the nerve inosculate? 143.
19. Where do the sensory nerve-fibres terminate, considering the stimulation carried? 144.
20. Where do the motor nerve-fibres terminate, considering impulses carried? 144.
21. Is the neurilemma endowed with sensitiveness? 144.
22. Of what does the white marrow-like substance of the brain and spinal cord, consist? 144.
23. What change takes place in nerve-fibres before entering at the periphery? 144.
24. How are the nerve-fibres arranged in the skin? 144.
25. How are the nerve-fibres subdivided in the peripheral plexus? 144
26. What is the sensory nerve-fibres' peripheral termination? 144.
27. What is the motor nerve-fibres' peripheral termination? 144.
28. Where are the **Tactile Corpuscles** situated? 145.
29. Where are the tactile corpuscles most numerous? 145.
30. What is the function of tactile corpuscles? 145.
31. Of what do tactile corpuscles consist? 145.

32. What becomes of the sheath and medullary layers of nerve-fibres on entering the tactile corpuscle? 145.
33. What part of the nerve-fibre enters the tactile corpuscle? 145.
34. On what does the high degree of sensibility of tactile corpuscles depend? 145.
35. Is there only one degree of quality in the **Sense of Touch**? 145
36. Mention some qualities of the sense of touch? 145.
37. To what class of sensation does **Pain** pertain? 145.
38. What effect have **Narcotics** on sensation? 145.
39. In *analgesia*, which sense is affected, and which not? 146.
40. Of what does a **Pacinian Body** consist? 146.
41. Where are the Pacinian bodies found? 146.
42. How is a Pacinian body connected with a nerve-fibre? 146.
43. What becomes of the sheath and medullary layer of the nerve-fibre on entering the Pacinian body? 146.
44. What part of the nerve-fibre enters the Pacinian body? 146.
45. What is the function of Pacinian bodies? 146.
46. Is the size, structure, and function of Pacinian bodies in all organs, alike? 146.
47. After the **Taliacotian Operation**, why is the seat of sensation changed? 146.
48. Which is the **Most Important** and necessary external **Sensation** of the vital economy? 146.
49. Give some illustrations why the sense of touch is the most important in the vital economy? 146.
50. Of what does a **Terminal Bulb** consist? 147.
51. Where are the terminal bulbs found? 147.
52. How does a nerve-fibre enter a terminal bulb? 147.
53. On what does the **Sense of Taste** depend? 147.
54. Give the three important factors in nervous operations? 147.
55. Where is the determinant point of an external sensation? 147.
56. Where are the **Terminal Plates** found? 147.
57. How do nerve-fibres penetrate the muscular fibres? 147.
58. What becomes of the sheath of the nerve-fibre when penetrating the muscular fibre? 148.
59. What is a **Terminal Plate**? 148.
60. What is the function of nerve-fibres? 148.
61. Why is the physiological attractive power of stimuli compared with a magnetic bar? 148.
62. What is physiological **Irritability** of a nerve? 148.
63. Do other tissues (not nerves) possess irritability? 148.
64. Give some illustrations of the irritability of tissues? 148.

65. What takes place within the nerve-fibre when an impulse passes through? 148.
66. What is the effect on the nerve-fibre when an impulse is strong or very prolonged? 148.
67. How can **Lost Nervous**, or **Muscular Irritability**, from over-excitation, be restored? 148.
68. How does cold, compression, or contusion affect the irritability and transmission of impulses? 148.
69. What nerve-fibres transmit impulses inward to nervous centres?
70. What nerve-fibres transmit impulses from nervous centres to peripheral organs? 148.
71. Of what nerve-fibres are the nerves generally composed? 148.
72. What is the difference of structure between **Sensory** and **Motor** nerve fibres? 148.
73. Where do the nerve-fibres branch off from the nerve? 148.
74. Give an illustration showing that the irritability of muscular, and motor nerve fibres are distinct? 148.
75. What irritability is destroyed by *Woorara*? 148.
76. How many **Kinds of Paralysis** are there? 149.
77. Are nerve-currents from stimulation instantaneous? 149.
78. How many stages are in sensation? 149.
79. Name the three stages in **Sensation**? 149.
80. What is the speed of transmission of **Motor** nerve-fibres? 149.
81. What is the speed of transmission in **Sensory** nerve-fibres? 149.
82. Are all transmissions of impulses through the spinal cord of the same speed? 149.
83. What is the speed of **Tactile** impressions through the cord? 149.
84. What is the speed of **Painful** impressions through the spinal cord? 149.
85. What is the speed of motor impulses through the spinal cord? 149.
86. What results in regard to transmission if a nerve is divided? 149.
87. What is the result in regard to transmission if the axis cylinder of a nerve-fibre is separated, though the sheath and white substance of *Schwann* remain intact? 149.
88. If a nerve-fibre is cut through, can it unite again? 149.
89. If a nerve containing hundreds of **Sensory** and **Motor** fibres, is divided, can each one of the fibres again unite as before? 149.

(Here, in this law of life, we have another proof of the great wisdom of the Creator, for if, in the process of healing, the sensory fibres would unite with motor fibres, confusion of function of the part affected would be the result. The proper union again of the sensory with sensory, and motor with motor nerve-fibres within the entire nerve, seems to contradict the theory of *Waller*. — *Vide* Law of Waller, in Schmitz's "Physiology," page 153.)

90. What **Time** is required for a divided large nerve to unite again?
91. What is the result on the parts supplied if small nerve branches are divided? 149.
92. What kinds of action on the system can be produced by **Electric Galvanic Currents**? 149.
93. How is a **Direct** electric current on nerve-fibres produced? 149.
94. How is an **Inverse** electric current on nerve-fibres produced?
95. What electric current produces muscular contraction of both, from commencement to termination of the muscle? 149.
96. When a nerve is exhausted by a direct electric current, how can it be made to respond again? 150.
97. How can a nerve be excited **Most Severely** by electric currents? 150.
98. What apparatus produces the alternate exciting direct and inverse currents? 150.

CHAPTER XVI.

THE SPINAL COLUMN.

1. Of what does the **Spinal Column** consist? 151.
2. Name the vertebral divisions of the spinal column? 151.
3. Why are the vertebræ of the first three divisions called *true vertebræ*? 151.
4. What is understood by *false* spinal vertebræ? 151.
5. By what are the true spinal vertebræ joined? 151.
6. For what purpose are the vertebræ provided with discs of fibro-cartilage? 151.
7. For what purpose is the spinal column provided with a cervical, dorsal, lumbar, and pelvic, curve? 151.
8. For what purpose are the dorsal and pelvic curves of the spine backward? 151.
9. For what purpose are the cervical, lumbar, and coccyx parts of the spine curved forward. 152.

THE SPINAL CORD.

10. What is the **Spinal Cord**? 152.
11. Of what does the spinal cord consist? 152.
12. Where does the central canal of the spinal cord commence, and where does it end? 152.
13. Of what does the gray substance of the spinal cord consist? 152.
14. Of what does the white substance of the spinal cord consist? 152.

15. Into how many fibrous tracts is each half of the spinal cord divided? 152.
16. Why does the spinal cord diminish in diameter toward its lower end? 152.
17. Why do the two halves of the spinal cord act as one organ? 152.
18. From what cells do the anterior nerve-roots of the spinal cord issue? 152.
19. What impulses do nerve-fibres issuing from the anterior spinal horns, carry? 152.
20. What nerve-fibres are connected with the posterior horns of gray matter of the spinal cord? 152.
21. What impulses do nerve-fibres entering the posterior spinal horns, carry? 152.
22. What shape or form have the cells of the anterior spinal horns?
23. What is the shape and size of cells of the posterior spinal horns?
24. How are the spinal cord and sympathetic system connected? 152
25. Thru what foramina do the spinal nerve-fibres issue from the cord? 152.
26. How many nerves are formed by nerve-fibres issuing from the spinal cord? 153.
27. How many nerves from the cervical portion of spinal cord? 153.
28. How many nerves from the dorsal portion of spinal cord? 153.
29. How many nerves from the lumbar portion of spinal cord? 153.
30. How many nerves from the sacral portion of spinal cord? 153.
31. How many nerves issue from the coccyx of the spinal cord? 153.
32. How many roots has each spinal nerve? 153.
33. Which nerve-fibres of the spinal cord are motor, and which sensory? 153.
34. What nerve-fibres pass thru the sympathetic ganglion before entering the spinal cord? 153.
35. Of what cells do the spinal sympathetic ganglia consist? 153.
36. In what direction is the nutritional activity of nerve-fibres? 153.
37. Which ends of the fibres degenerate in section of a posterior nerve-root between the cord and sympathetic spinal ganglion?
38. Which ends of the fibres degenerate in section of an anterior spinal nerve-root? 153.
39. To what extent does the fibre degenerate in section of a motor nerve-fibre near the spinal cord? 153.
40. Where do the motor nerve-fibres of the brain hemispheres **Decussate** before entering the spinal cord? 154.
41. What do motor nerve-fibres of the brain enter within the spinal cord, before leaving it? 154.

42. Do all brain motor nerve-fibres decussate before entering the spinal cord? 154.
43. Brain motor nerve-fibres that do not decussate before entering the spinal cord, where do they pass to? 154.
44. What is the **Route** of an impulse through a sensory nerve-fibre from a peripheral organ to the brain? 154.
45. Do the cerebro-spinal sensory nerve-fibres decussate similar to the motor? 154.
46. Where are the spinal nerves formed? 154.
47. What classes of nerve-fibres are contained in spinal nerves? 154.
48. What is the exclusive organ through which all communications to and from the brain, body, and limbs, have to pass? 154.
49. Do any nerve-fibres originate in the spinal cord? 154.
50. What muscles and muscular-fibres are supplied by nerve-fibres that originate in the spinal cord? 154.
51. From what are nerve-fibres derived that supply the small intestine, cæcum, and colon? 154.
52. From what are the nerve-fibres derived that supply the rectum, its mucous membrane and sphincter muscles? 154.
53. By what are the retention and discharge of **Feces** effected and regulated? 154.
54. What muscles keep the *anus* closed? 154.
55. By what muscle is the *rectum* opened? 154.
56. Does an external stimulus to the *sphincter ani* close or open the anus? 154.
57. Is the habitual closure of the anus voluntary, or involuntary? 154.
58. What is the stimulus for the evacuation of the feces? 154.
59. Where is the lesion when the feces pass off without the knowledge of the patient? 155.
60. What arteries supply blood to the spinal cord? 155.
61. At what parts is the spinal cord enlarged in diameter? 155.
62. What parts of the body do nerves issuing from the spinal **Cervical** enlargement, supply? 155.
63. What parts of the body do nerves issuing from the spinal **Dorsal** enlargement, supply? 155.
64. What parts of the body do nerves issuing from the **Lumbar** enlargement, supply? 155.
65. Does the spinal cord contain nervous centres independent of the brain in their reflex functions? 155.
66. How many spinal reflex centres are independent of the brain? 155.
67. Name the four spinal reflex centres independent of the brain? 155.
68. Where is the **Cilio-spinal** reflex centre situated? 155.

69. Where is the **Genito-spinal** reflex centre? 155.
70. Where is the reflex centre for **Parturition** pains? 155.
71. Where are the **Ano-spinal** and **Vesico-spinal** centres? 155.
72. Suppose the ano-spinal and vesico-spinal centres lose their reflex functions, what is the result? 155.
73. What respiratory muscles are affected in section of the spinal cord between the seventh and twelfth dorsal vertebræ? 155.
74. What respiratory muscles are effected, in section of the spinal cord between the first and ninth dorsal vertebræ? 155.
75. What respiratory nerve and muscles are affected in section of the spinal cord between fifth and seventh cervical vertebræ? 155.
76. What respiratory nerve and muscle are affected, in section of the spinal cord between third and fourth cervical vertebræ? 155.
77. What are the **Three-fold** principal functions of the spinal cord as a whole? 156.
78. What spinal cord reflex cannot be inhibited by the will? 156.
79. Of what use is the urinary bladder? 156.
80. How is the bladder provided so as to retain the urine from time to time? 156.
81. What is the source of nerve-fibres to the urinary bladder? 156.
82. From what source are the nerve-fibres that supply the upper part of the neck of the urinary bladder? 156.
83. From what source are the nerve-fibres that supply the lower part of the neck of the urinary bladder? 156.
84. Is the contraction and relaxation of the *sphincter vesicæ* voluntary, or involuntary? 156.
85. What muscle and muscular-fibres act during *micturation*? 156.
86. What is the nervous operation when the will influences urination? 156.
87. What is the result on the urinary bladder in lesion of the *hypogastric plexus*? 156.
88. What is the result on the urinary bladder in lesion of the *sacral plexus*? 156.
89. Thru what nerves do the principal spinal reflex impulses pass for the contraction of the urinary bladder? 156.
90. What effect on the bladder and urination has inflammation of the bladder, or increased acidity of the urine? 156.
91. What effect on urination has paralysis of the bladder? 156.
92. Normally, of **What Kind** are all the reflex actions of the spinal cord? 157.
93. Give some acts of organs, caused by reflex action of the spinal cord, over which the will has little or no control? 157.

94. Where does the decussation of the cerebro-spinal motor and sensory nerve-fibres take place? 157.
95. What side of the body is affected in a lesion of the lateral half of the brain above the medulla oblongata? 157.
96. What side of the body is affected in a lesion of the lateral half of the spinal cord? 157.
97. What is **Hemiplegia**? 157.
98. What is **Paraplegia**? 157.
99. What parts of the body are affected, and how, in a lesion of the middle entire spinal cord transversely? 157.
100. How can we determine the **Seat of Lesion** in any part of the spinal cord? 157.
101. What parts of the body and limbs are affected in a lesion of the lumbar portion of the spinal cord? 157.
102. What parts of the body and limbs are affected in a lesion of the dorsal portion of the spinal cord? 157.
103. What parts of the body and limbs are affected in a lesion of the middle cervical portion of the spinal cord? 157.
104. What is the effect on the body in lesion just above the middle cervical portion of the spinal cord? 157.
105. Where does the **Phrenic Nerve** arise? 157.
106. What does the phrenic nerve supply? 157.
107. What is the physiological effect of **Strychnine**? 157.
108. How may a wound on the periphery or limbs produce **Tetanic spasms**? 157.
109. Has the will any power over spasms of **Hydrophobia**, or **Tetanus**? 157.
110. What parts of nervous system are involved in hydrophobia? 158.
111. How is hydrophobia produced? 158.
112. What stimulus is most effective in bringing on convulsions, when hydrophobia is once established? 158.
113. What external senses are liable to bring on spasms in hydrophobia? 158.
114. What is **Tetanus**? 158.
115. What external sense is liable to bring on spasms of tetanus? 158.
116. What medicine produces irritation resembling tetanus? 158.
117. What lesions can cause tetanus? 158.
118. Would amputating the injured limb prevent tetanic spasms at any stage of the disease? 158.
119. What is **Epilepsy**? 158.
120. What may be the cause of epilepsy? 158.

121. How may death result from epileptic convulsions? 158.
 122. What is **Hysteria**? 158.
 123. What diagnostic feature exists between epilepsy and hysteria?
 124. What is **Meningitis**? 158.
 125. Where is the inflammation in spinal meningitis accompanied with great pain? 159.
 126. Where is the inflammation in convulsions from spinal meningitis, but without pain? 159.
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CHAPTER XVII.

THE SYMPATHETIC SYSTEM.

1. Of what does the **Sympathetic** nervous system consist? 160.
2. Is the sympathetic nervous system independent of the cerebro-spinal system? 160.
3. How are the sympathetic and cerebro-spinal nervous systems, connected? 160.
4. How are the sympathetic **Ganglia** arranged on the sides of the spinal column? 160.
5. How are the sympathetic ganglia arranged in the body? 160.
6. What is a nervous **Ganglion**? 160.
7. What kinds of cells do the ganglia contain? 160.
8. Do all sympathetic nerve-fibres contain a medullary layer? 160.
9. Of what source are the **Medullated** nerve-fibres of the sympathetic ganglia, and what do they supply? 160.
10. Of what source are the **Non-medullated** nerve-fibres of the sympathetic ganglia, and what do they supply? 160.
11. By what is the sympathy between the organs of the body, established? 160.
12. In what manner do nerve-fibres supply the blood and lymphatic vessels? 160.
13. What ganglia act as **Protectors** for the nervous centres, so as to prevent over-irritation? 160.
14. Thru what ganglion of the cerebrum do the sensory fibres of the spinal cord pass to the cerebral convolutions? 160.
15. To what parts of the body is the sympathetic system most largely distributed? 161.
16. About how many **Nervous Plexus** are in the body? 161.
17. Name twelve nervous plexus of the body? 161.

18. What is the difference between a nervous **Ganglion** and a nervous **Plexus**? 162.
19. What is understood by **Ganglion-Plexus**? 162.
20. What are the **Nervous Actions** affecting peristalsis of the œsophagus, stomach, and intestines? 162.
21. Where are the reflex centres for the peristaltic action of the œsophagus, stomach, and intestines? 162.
22. Where are the vaso-motor centres **Situated** for the dilatation and contraction of the vascular system? 162.
23. Give the **Route** of the vaso-dilator and contractor impulses from the medulla oblongata to abdominal organs? 162.
24. Are the cerebro-spinal and sympathetic nerve-fibres of the same diameter? 162.
25. Over what functions does the cerebro-spinal nervous system principally preside? 162.
26. Over what functions does the sympathetic nervous system principally preside? 162.
27. What organs are principally supplied by nerve-fibres of the sympathetic system? 162.
28. What are the functions of the sympathetic nervous centres, or ganglia? 162.
29. Which of the **Two Great Divisions** of the nervous system requires the most continued stimulation, and is the least rapid in its actions? 162.

CHAPTER XVIII.

THE SENSES.

The study of **Sensation** is a difficult matter, inasmuch, as it involves a knowledge:—

1. Of **Physics** (*natural philosophy*), the science of the accidental changes of matter; extending, therefore, to gravitation, heat, light, sound, magnetism, electricity, cohesion, etc.

2. Of **Chemistry**, the science of substantial changes.

3. **Physiology**, the science of the laws of life and functions of living organisms.

4. Of **Psychology** (a branch of *Metaphysics*), the science of the powers and functions of the human soul.

From time immemorial till now, great efforts have been made by physiologists to enumerate and classify sensations as simple material functions, but all have failed; for instance, the sensations of seeing,

hearing, smelling, tasting, touching, of hunger, thirst, orgasm, faintness, discomfort, fatigue, burning, pain, want, appreciation of quantity or quality, roughness or smoothness, restlessness, satisfaction, comfort or discomfort, the pleasant or unpleasant sensation of a kind or unkind word, happiness or unhappiness, and many others.

In studying the chapter on "*The Senses*" (see Schmitz's "Physiology") it will be noticed that sensations are classified under nine heads; *five for the external senses*, sight, hearing, smell, taste, and touch; and *four for the internal senses*, such as common sense, imagination, estimative faculty or instinct, and sensitive memory.

Intentionally, no questions have been prepared on the chapter of "The Senses," because it should be studied and comprehended thoroughly as a whole. In Schmitz's "Physiology," pages 163, 164, 165, 166, 167, 168, and 169, the subject of the *Senses* is plainly, intelligently, and comprehensively laid down.

In considering the chapter on "**The Senses**," a student seeking for further explanation, inquired what constituted the difference between "**Intellect**" and "**Instinct**"?

In order, therefore, to give a few more ideas on this subject, we must go outside of physiology, and dabble a little in *metaphysics*.

We have already considered (see the above mentioned "Physiology") the **Nine Classes of Senses**, that is, the five external and the four internal senses, and found that they are organic, and possessed by all the *higher* animals. So we may say, whatever is received, is received according to the nature of the recipient. The internal senses are the discriminating senses between the properties of objects presented to them through the external senses, not, however, says *Hill* in his *philosophy*, by way of a formal judgment; but by a true, though sensible appreciation of them. The proper sensible is perceived by one sense only, and it cannot be apprehended by another; in regard to it, the sense cannot err when acting normally. The common sensible can be perceived by more senses than one, and in respect to it the sense can err. It is for that reason, that they, in whom the internal senses, imagination, estimative faculty, and sensitive memory are best disposed, are best fitted to understand; hence, the beginning of our knowledge is from the senses; yet, we have noticed that the sense organ of man as well as of the animal, is essentially dependent on matter.

We will now in the following show, that "*Intelligence*" is absolutely immaterial, and entirely super-sensible. We have on a previous occasion (page 56) fully explained, that the material *animal* body and

spiritual soul constitute *one physical* compound. Now we may add, that no spirit which is dependent on matter, both in existing and operating, can reflect fully on its own acts. We have also shown that the human material body and spiritual soul are **Two Separable** realities, and that this independent separable soul, is on that account *rational*, and can reflect on its own acts; therefore, the rational (intellectual, reasonable) soul is superior to matter, both in its essence and its action. The body is required for the action of the intellect, not as an organ by which such action is exercised, but on account of the object.

The **Estimative Faculty**, or **Instinct**, is a property of the sentient soul, analogous, though inferior, to rational judgment. **Judgment** is an act of the mind or soul by which it affirms the agreement or disagreement of two concepts or ideas; consequently, judgment is a choice resulting from reason. **Instinct** is a blind impulse impelling the animal to act in a restricted, specific manner. That animal instinct is different, says *Maher* in his *psychology*, not in *degree*, but in *kind* from human intellect, the following example may illustrate the difference: The young female wasp, without maternal experience, will seize caterpillars or spiders, and stinging them in a certain definite spot, paralyze and deprive them of all power of motion (probably also of sensation), without depriving them of life. She places them thus paralyzed in her nest with her eggs, so that, when her young are hatched, they may live on the alive though helplessly paralyzed prey. Now, it is absolutely impossible that the consequences of its actions can have been intellectually apprehended by the parent wasp; for, says *Mivart* in his *Lessons from Nature*, had she (the parent wasp) *Reason* without her natural *Instinct* she could only learn to perform such actions through experience.

Maher defines "*Instinct* as a natural aptitude which guides animals in the unreflecting performance of complex acts useful for the preservation of the individual or of the species." We notice then, that this natural aptitude and performance of acts is independent in the animal of any reasoning or intelligence. The sense is of singulars; the intellect, of universals.

CHAPTER XIX.

THE CRANIAL NERVES.

1. How many **Pairs of Cranial Nerves** are there? 170.
2. Name the twelve pairs of cranial nerves? 170.
3. Give the general **Classification** of the cranial nerves? 170.
4. What cranial nerves belong to the **Sensory** class? 170.
5. What cranial nerves belong to the **Motor** class? 170.
6. What cranial nerves belong to the **Mixed** class, that is, containing sensory and motor nerve-fibres? 170.
7. At what part of the *medulla oblongata* and *pons Varolii* do the nervous centre cells give off the sensory, at what part the motor nerve-fibres? 170.
8. What is the name of the **First Pair** of cranial nerves? 171.
9. Of what sense does the **Olfactory Nerve** carry impulses? 171.
10. From how many roots does the olfactory nerve arise? 171.
11. Where does the external root of the olfactory nerve arise? 171.
12. Where does the middle root of the olfactory nerve arise? 171.
13. Where does the internal root of the olfactory nerve arise? 171.
14. When the three roots of the olfactory nerve have coalesced, to what bulb do they pass? 171.
15. Where is the **Olfactory Bulb** situated? 171.
16. How many nerve-fibres issue from the olfactory bulb? 171.
17. Where do the nerve-fibres issuing from the olfactory bulb, terminate? 171.
18. How is the **Schneiderian** membrane situated in the nose? 171.
19. How are the nervous centres of the olfactory nerve of both hemispheres, in communication? 171.
20. By what does the olfactory nerve differ from other nerves? 171.
21. What effect has a large or small olfactory bulb in regard to the functions of smell? 171.
22. What effect has congenital absence, or disease of the olfactory bulb, on smell? 171.
23. What are the three necessary conditions for smelling? 171.
24. What effect on smell has a dry membrane of the nose? 172.
25. When respiration is interrupted, what is the effect on smell? 172.
26. In what condition must the stimulus come in contact with the *Schneiderian* membrane, for smelling? 172.
27. What are the five normal chief functions of the nose? 172.

28. Why is the smell of a substance lost when in continual contact with the *Schneiderian* membrane? 172.
29. Do the stimuli of smell and those of cold, heat, tickling, and pain of the nasal membrane, pass thru the same nerve-fibres?
30. What nerve carries the sensation of heat, cold, itching, and pain, of the nasal membrane? 172.
31. How do we know the olfactory nerve does not carry the sensations of cold, heat, itching, and pain, of the nasal membrane?
32. To what sense do the sensations of cold, heat, tickling, and pain, pertain? 172.
33. Have all individuals the same appreciation of a pleasant odor?
34. Where are the nervous centres of smell, and taste, located? 172.
35. What is the name of the **Second Pair** of cranial nerves? 172.
36. Where do the fibres of the **Optic Nerves** originate? 172.
37. How is the **Optic Commissure** formed? 172.
38. Where do the optic nerves proper, form? 172.
39. Where do the optic nerves leave the cranium? 172.
40. Externally, where do the optic nerve-fibres terminate? 172.
41. How is each optic nerve in **Communication** with both hemispheres? 172.
42. Of what nerve do the fibres run a longer course within, than without the cranium? 172.
43. Whence is the **Neurilemma** of the optic nerve derived? 173.
44. Of what use is the **Decussation** of the fibres of the optic nerve?
45. What impulse does the optic nerve carry? 173.
46. What organs are required for the **Completion** of the sense of sight? 173.
47. What part of the eye receives the stimulus of vibrations of the luminous ether for sight? 173.
48. Is section of the optic nerve painful? 173.
49. How is it that in **Hemiplegia** partial blindness of both eyes may occur? 173.
50. How is it that stimulus applied to one eye may cause contraction of the pupils of both eyes? 173.
51. What is the name of the **Third Pair** of cranial nerves? 174.
52. What impulses does the **Oculomotorius Nerve** carry? 174.
53. How many muscles of the eye are supplied by the oculomotorius nerve? 174.
54. Where do the nerve-fibres of the oculomotorius nerve originate?
55. Where does the oculomotorius nerve pass out of the skull? 174.
56. What physiological properties has the oculomotorius nerve? 174.
57. What is the result when the oculomotorius nerve is paralyzed? 174

58. What is the name of the **Fourth Pair** of cranial nerves? 174.
59. Where do the fibres of the **Trochlearis Nerve** originate? 174.
60. Where does the trochlearis nerve pass out of the skull? 174.
61. What does the trochlearis nerve supply? 174.
62. What is the physiological property of the trochlearis nerve? 175.
63. What is the result in paralysis of the trochlearis nerve? 175.
64. What is the result of a lesion at the origin of the trochlearis nerve-fibres at one hemisphere? 175.
65. What is the name of the **Fifth Pair** of cranial nerves? 175.
66. From how many roots does the **Trigeminus Nerve** arise? 175.
67. Where is the origin of nerve-fibres of the **Sensory** root of the trigeminus nerve? 175.
68. Where is the origin of nerve-fibres of the **Motor** root of the trigeminus nerve? 175.
69. Which cranial nerve contains the most nerve-fibres. 175.
70. Through what **Ganglion** does the trigeminus nerve pass? 175.
71. Where is the **Gasserion Ganglion** situated? 175.
72. What functional impulses does the trigeminus nerve carry? 175.
73. What parts does the trigeminus nerve supply? 175.
74. How many nerves are given off from the *Gasserian* ganglion? 176.
75. What nerves issue from the *Gasserian* ganglion? 176.
76. What impulses does the **Ophthalmic Nerve** carry? 176.
77. What does the ophthalmic nerve supply? 176.
78. How many branches are given off from the ophthalmic nerve? 176.
79. Name the branches of the ophthalmic nerve? 176.
80. Where do the branches of the ophthalmic nerve pass out of the cranium? 176.
81. What is the result if the nasal branch of the ophthalmic nerve be injured? 176.
82. If the nasal branch of the ophthalmic nerve is injured or irritated, how can it affect the sense of smell? 176.
83. What impulses does the **Superior Maxillary Nerve** carry? 176.
84. Where does the superior maxillary nerve pass out the cranium? 176.
85. What does the superior maxillary nerve supply? 176.
86. What impulses does the **Inferior Maxillary Nerve** carry? 176.
87. Where does the inferior maxillary nerve pass out of the cranium? 176.
88. What does the inferior maxillary nerve supply? 177.
89. What is the function of the lingual branch of the inferior maxillary nerve? 177.
90. Why is taste marred with a tongue dry or coated? 177.
91. What muscles bring the teeth of the lower jaw powerfully in contact with the upper? 177.

92. What effect on mastication has paralysis of the muscular branch of the inferior maxillary nerve on one side of the face? 177.
93. What effect on the eyes has an injury of the trigeminus nerve or *Gasserian* ganglion? 177.
94. Where are the cerebral areas or centres of taste and smell situated? 177.
95. What is the name of the **Sixth Pair** of cranial nerves? 177.
96. Where do the fibres of the **Abducens Nerve** originate? 177.
97. What impulses does the abducens nerve carry? 177.
98. What does the abducens nerve supply? 177.
99. Where does the abducens nerve pass out of the cranium? 178.
100. Why is the abducens nerve very liable to partial or complete paralysis? 178.
101. What is the result if one abducens nerve is paralyzed? 178.
102. What affections of the eye may produce strabismus? 178.
103. What is the name of the **Seventh Pair** of cranial nerves? 178.
104. Where do the fibres of the **Facial Nerve** originate? 178.
105. How does the facial nerve pass out of the cranium? 178.
106. What are the communications of the facial nerve before entering the integument of the face? 178.
107. Where does the *chorda tympani* nerve commence? 178.
108. What does the *chorda tympani* nerve supply? 178.
109. What impulse does the facial nerve carry? 178.
110. What does the facial nerve supply? 178.
111. What effect on the face has paralysis of the facial nerve? 179.
112. What effect on the nose has paralysis of the facial nerve? 179.
113. What is understood by *Bell's paralysis*? 179.
114. What nerve is paralyzed in paralysis of the face on one side, the mouth being drawn over to the other side? 180.
115. What is the name of the **Eighth Pair** of cranial nerves? 180.
116. From how many roots does the **Auditory Nerve** arise? 180.
117. What nerve carries the impulses of sound from the cochlea and vestibule of the internal ear? 180.
118. What nerve carries the impulses for maintaining the equilibrium of the head and body? 180.
119. What is the result of irritation or disturbance of the semicircular canals of the internal ear, on the head and body? 180.
120. What is the name of the **Ninth Pair** of cranial nerves? 181.
121. What nerve-fibres does the **Glosso-pharyngeal Nerve** contain? 181.
122. Where do the fibres of the glosso-pharyngeal nerve arise? 181.
123. What does the glosso-pharyngeal nerve supply? 181.

124. Where is the glosso-pharyngeal nerve formed? 181.
125. What other nerves accompany the glosso-pharyngeal in passing out of the cranium? 181.
126. Where does the glosso-pharyngeal nerve pass out the cranium?
127. Thru what **Ganglion** does the glosso-pharyngeal nerve pass?
128. In function, what impulses does the glosso-pharyngeal nerve transmit? 181.
129. Is **Deglutition** voluntary, or involuntary? 181.
130. What is the normal **Stimulus** for deglutition? 181.
131. Explain the nervous action when food or liquid stimulates the throat for deglutition? 181.
132. Why do abnormal, nauseous, or irritating substances in the pharynx produce vomiting? 182.
133. With how many nerves is the tongue supplied? 182.
134. What nerves supply the tongue? 182.
135. How many varieties of **Terminal Bulbs** are there for taste in the tongue? 182.
136. Name the four varieties of taste? 182.
137. Which senses of taste are easily impaired, and which not? 182.
138. What receives the stimulation in the tongue for taste? 182.
139. What nerves carry the sensory impulses of the tongue? 182.
140. At what part of the tongue is the taste for sweet and acid substances most acute? 182.
141. At what part of the tongue is the taste for bitter and saline substances most acute? 182.
142. Has the number of terminal bulbs any influence on taste? 182.
143. What is **Hypergeusia**? 182.
144. What is **Hypogeusia**? 182.
145. What is **Ageusia**? 182.
146. What condition is required of any substance before it can excite the sense of taste? 182.
147. What is the sensation of an insoluble substance on the tongue?
148. What external sense is in close relation with that of taste? 182.
149. What effect on taste has closing the nose? 182.
150. What part of the tongue most quickly induces **Nausea** and **Vomiting** on tasting an unpleasant substance? 182.
151. What nerve supplies the mucous membrane and papillæ of the root of the tongue? 183.
152. What nerve supplies the muscular portion of the tongue? 183.
153. What nerve supplies the taste bulbs and mucous membrane of the anterior two-thirds part of the tongue? 183.
154. How do substances tasted penetrate the papillæ of the tongue?

155. Why cannot different substances be tasted in quick succession?
156. What is the name of the **Tenth Pair** of cranial nerves? 183.
157. What nerve-fibres does the **Pneumogastric Nerve** contain?
158. Where do the sensory fibres of the pneumogastric nerve arise?
159. What is the source of the motor fibres of the pneumogastric? 183
160. How many branches ramify from the pneumogastric nerve? 183
161. Name the branches of the pneumogastric nerve? 183.
162. Where is the pneumogastric nerve proper formed? 183.
163. Where does the pneumogastric nerve pass from the cranium? 183
164. What does the pneumogastric nerve supply? 183.
165. Thru what nerve are the sensory impulses for respiration and circulation conveyed? 183.
166. To what nerve do the sensory fibres supplying the wall of the stomach, belong? 183.
167. What is the name of the **Eleventh Pair** of cranial nerves? 184.
168. From how many roots does the **Spinal Accessory Nerve** arise? 184.
169. Give the origin of nerve-fibres of the two roots of the spinal accessory nerve? 184.
170. How do the nerve-fibres of the spinal accessory arising at the spinal cord get into the cranium? 185.
171. What nerve incorporates the spinal accessory nerve-fibres in passing out of the cranium? 185.
172. Where do the pneumogastric and spinal accessory nerve-fibres pass out of the cranium? 185.
173. What does the spinal accessory nerve supply? 185.
174. What effect on the voice has section or injury of the spinal accessory nerve? 185.
175. What organs of the throat are paralyzed in section of the pneumogastric nerve? 185.
176. What is the name of the **Twelfth Pair** of cranial nerves? 186.
177. Where do the fibres of the **Hypoglossal Nerve** arise? 186.
178. Where is the hypoglossal nerve proper formed? 186.
179. Where does the hypoglossal nerve pass out of the cranium? 186.
180. What impulses does the hypoglossal nerve carry? 186.
181. What does the hypoglossal nerve supply? 186.
182. In what brain hemisphere is the lesion, when one side of the face and tongue are paralyzed? 186.
183. Which muscle is affected, and which not, when, in protusion, the tongue is drawn to one side? 186.
184. For what is the motor influence of the hypoglossal nerve essential? 186.

CHAPTER XX.

THE EYE AND THE SENSE OF SIGHT.

1. What is **Bulbus Oculi**? 187.
2. What holds the eyeball in position? 187.
3. What is the situation of the **Sclerotica** of the eye? 187.
4. Where is the **Cornea** of the eye situated? 187.
5. What is the structure of the cornea of the eye? 187.
6. What is the structure of the sclerotica of the eye? 187.
7. What muscles are inserted in the sclerotica of the eye? 187.
8. What is the structure of the **Choroid Coat** of the eye? 187.
9. Where is the choroid coat of the eye situated? 187.
10. What effect has the choroid coat of the eye in regard to light? 187
11. What is the structure of the **Hyaloid Membrane** of the eye?
12. Where is the hyaloid membrane of the eye situated? 187.
13. Of what use are the processes of the hyaloid membrane of the eye?
14. What is the structure of the **Vitreous Body** of the eye? 187.
15. Where is the vitreous body of the eye situated? 187.
16. What is the composition of the vitreous body of the eye? 187.
17. How is the vitreous body of the eye nourished? 187.
18. Of what use are the multipolar cells in the vitreous body of the eye? 188.
19. What is the composition of the **Aqueous Humor** of the eye?
20. Where is the aqueous humor of the eye situated? 188.
21. What divides the cavity of the eye containing the aqueous humor into two chambers? 188.
22. What is the boundary of the **Anterior Chamber** of the eye? 188
23. What is the boundary of the **Posterior Chamber** of the eye?
24. Where is the **Ciliary Muscle** of the eye situated? 188.
25. How can the ciliary muscle, during contraction, facilitate accommodation of sight for different distances? 188.
26. From what source are the arteries and nerves supplying the ciliary muscle of the eye? 188.
27. Where is the **Ciliary Ligament** of the eye situated? 189.
28. Where is the **Canal of Schlemm** in the eye situated? 189.
29. What parts of the eyeball are connected by the ciliary ligament?
30. Where is the **Suspensory Ligament** of the eye situated? 189
31. Of what use is the suspensory ligament of the eye? 189.
32. Where is the **Canal of Petit** of the eyeball? 189.

33. What is the meaning of **Iris**? 189.
34. What is the structure of the iris? 189.
35. Where is the iris situated? 189.
36. What is the function of the iris? 189.
37. What divides the cavity between the cornea and the crystalline lens into two chambers? 189.
38. What causes the **Pupil** to become small when light enters the eye? 189.
39. What nerve carries the **Sensory** fibres of the eye? 189.
40. What nerve carries the **Motor** fibres of the eye? 189.
41. Describe the nervous operation when rays of light enter the eye, causing the pupil to contract? 189.
42. What effect has the destruction of the **Corpora Quadrigemina** on the iris, or pupil? 189.
43. Besides light, what condition of the eye may cause contraction of the pupil? 190.
44. What vegetable remedies cause contraction of the pupil? 190.
45. Why is sight obscured temporarily on passing suddenly from light into darkness? 190.
46. Why is the eye dazed temporarily on passing suddenly from darkness to bright light? 190.
47. Why does strong light on one eye cause contraction of the pupils of both eyes? 190.
48. How can powerful brilliant light produce lesion of the retina? 190.
49. Thru what ganglion do the reflex impulses for contraction and expansion of the iris (pupil), pass? 190.
50. Give the name and situation of the reflex nervous centre for the **Contraction** of the pupil? 190.
51. Give the name and situation of the reflex nervous centre for the **Dilatation** of the pupil? 190.
52. What effect has section of the oculomotorius nerve on the iris? 190.
53. What condition of the eye can produce dilatation of the pupil? 190.
54. What vegetable remedies cause dilatation of the pupil? 190.
55. What nerve supplies the circular muscle-fibres of the iris? 190.
56. What remedies stimulate the pupil contracting-centre, and paralyze the dilator? 191.
57. What remedies stimulate the pupil dilating-centre, but paralyze the contractor? 191.
58. What is the **Lens** of the eye? 191.
59. What is the size of the lens of the eye? 191.
60. What is the weight of the lens of the eye? 191.
61. What is the structure of the lens of the eye? 191.

62. Of what is the lens of the eye composed? 191.
63. What is the function of the lens of the eye? 191.
64. How many **Ciliary Processes** are there in the eye? 191.
65. Where are the ciliary processes of the eye situated? 191.
66. What is the **Retina** of the eye? 191.
67. Where is the retina of the eye situated? 191.
68. What is the thickness of the retina of the eye? 191.
69. What is the most sensitive spot of the retina for sight? 191.
70. What is the **Macula Lutea** of the eye? 191.
71. What nerve-fibres does the **Optic Nerve** contain? 192.
72. What impulses do the optic nerve-fibres carry? 192.
73. Where do the optic nerve-fibres receive the impulses, transmitted? 192.
74. To what do the optic nerve-fibres transmit the impulses? 192.
75. Why is it that in stimulation of the optic nerve (mechanically or electrically) the sensation of light is produced? 192.
76. How many muscles are attached to the sclerotic coat of the eye?
77. Which muscle moves the eye outward, which inward, upward, and downward? 192.
78. What nerves carry the impulses for the action of the eye-muscles?
79. What nerve carries the sensory impulses of the eyeball and lid?
80. Through what **Ganglia** do the sensory fibres of the fifth, and motor fibres of the third cranial nerves, pass to the eye. 192.
81. Of all the parts that make up the eye, what part is the most important for sight? 192.
82. Of what use are the eyelids or *palpebræ*? 192.
83. What muscle moves the upper eyelid upward? 192.
84. Of what use is the *tarsus*, or cartilage, within the eyelid? 193.
85. How many **Meibonian Glands** are in the eyelid? 193.
86. What is the function of the *Meibonian* glands in the eyelid? 193.
87. What is understood by **Conjunctiva**? 193.
88. Where is the *lachrymal* canal situated? 193.
89. What is the size of the *lachrymal* gland? 193.
90. Where is the *lachrymal* gland situated? 193.
91. What is the function of the *lachrymal* gland? 193.
92. What nerve supplies the *lachrymal* gland? 193.
93. What muscle contracts the eyelids? 193.
94. What muscle opens the eyelids? 193.
95. What muscle closes the eyelids? 193.
96. Of what use is the continual winking of the eyelids? 193.
97. What is meant by **Accommodation** of the eye? 193.
98. How is an object seen? 193.

99. Is **Light** itself visible? 193.
100. What is an **Image**? 193.
101. What is the action in the seeing of objects? 193.
102. Give an example to prove that the reflexion of rays from an object is the reason why we see them? 194.
103. How is the power of estimating distance by sight acquired? 194.
104. Why is it that in two persons, one one-eyed, the other two-eyed, both can see equally far, yet the one-eyed cannot see the object as clearly, nor estimate the size and distance, as well as the two-eyed person? 194.
105. Give an example to show that a person with one eye cannot estimate distance as well as one with two eyes? 194.
106. Why is it that a one-eyed person cannot estimate distance as well as one with two eyes? 194.
107. What time is required for the eye in changing accommodation from a near to a distant object? 194.
108. At what distance from the eye is accommodation not necessary?
109. How close to the eye can accommodation take place? 194.
110. What is the **Range** of accommodation of the eye? 194.
111. What structure of the eye accomplishes accommodation? 194.
112. What is the change in the lens of the eye for a near object? 194.
113. What is the change in the lens of the eye for a distant object?
114. What structures of the eye must light traverse before it focuses properly on the retina? 195.
115. What muscles bring about a change in the figure of the eye-lens?
116. What effect has old age on the lens of the eye for accommodation? 195.
117. When the lens of the eye has lost its power of accommodation, how can it be remedied? 195.
118. To render parallel rays on the eye more convergent, what kind of lens should be used in eye-glasses? 195.
119. To render parallel rays on the eye more divergent, what kind of lens should be used in eye-glasses? 195.
120. What is understood by **Focal Point**? 195.
121. Does a powerful lens shorten or lengthen the focal distance? 195
122. What effect on accommodation has the absence of the eye-lens?
123. Why is the entrance of the optic nerve in the retina of the eye-ball a blind spot? 196.
124. Where is the most acute **Area of Vision** in the eye? 196.
125. Where is the **Macula Lutea** in the eye situated? 196.
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131. What are the terminal organs of the optic nerve-fibres in the retina? 196.
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CHAPTER XXI.

THE EAR AND THE SENSE OF HEARING.

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4. What part of the organ of hearing receives the impressions of sound, analyzes their quality, pitch, and intensity? 200.
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12. What are the three muscles of the pinna or auricle? 200.
13. Of what use are the three muscles of the pinna or auricle? 200.
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15. What constitutes the **Tragus** of the pinna or auricle? 201.
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21. Of what good is the *oblique* slope of the *membrana tympani*? 201
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23. What prevents the *membrana tympani* from vibrating oftener than the sound-waves strike it? 202.
24. For what purposes is the *malleus bone* attached to the *membrana tympani*? 202.
25. What muscle produces tension of the *membrana tympani*? 202.
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27. How is the *tensor tympani muscle* called into action? 203.
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44. What separates the middle ear from the brain? 204.
45. What may be the effect of an abscess in the periosteum of the roof of the middle ear on the brain? 204.
46. What large blood-vessels pass just on the outside of the floor of the middle ear? 204.
47. Why may fatal hæmorrhage result, if the floor of the middle ear is ruptured, in an accident? 204.
48. Why may a good swimmer drown in water if the membrana tympani is perforated? 204.
49. Of what does the **Malleus** bone consist? 204.
50. What bone articulates with the malleus bone? 204.
51. What muscles are attached to the malleus bone? 204.
52. What bone takes part in the vibrations of the membrana tympani, and yet acts on it as a damper? 204.
53. What difference is there in the extent of vibrations, and power, between the membrana tympani and the membrane of the fenestra ovalis? 204.
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55. What bones articulate with the incus bone? 204.
56. What holds the incus bone in position? 204.
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58. What bone articulates with the stapes? 205.
59. What muscle is attached to the stapes bone? 205.
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62. Of what use are the three bones in the middle ear? 205.
63. What is the result on hearing, in case of **Anchylosis** of the malleus, incus, and stapes bones? 205.
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65. What is the function of the **Laxator Tympani** muscle in the ear? 205.
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80. What is understood by the **Membranous Labyrinth**? 206.
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84. Of what use is the **Aqueduct Cochlearis** of the ear? 206.
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89. What passes thru the **Internal Auditory Meatus**? 206.
90. What is understood by the **Vestibule** of the ear? 206.
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95. What causes the membrane of the fenestra ovalis to vibrate? 207.
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99. By how many **Orifices** do the semicircular canals communicate with the vestibule of the ear? 207.
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104. Where are the **Otoliths** and **Otoconia** of the ear? 207.
105. Of what are the otoliths and otoconia of the ear composed? 207.
106. Of what use are the otoliths and otoconia of the ear? 207.
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135. What constitutes the **Modiolus** of the internal ear? 210.
136. What constitutes the anterior portion of the internal ear? 210.
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138. Where does the modiolus of the cochlea terminate? 210.
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152. What is the function of the membrane of *Reisner*? 212.
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154. To what is the *membrana Basilari* of the ear attached? 212.

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158. Are the *rods of Corti* all of the same size and length? 212.
159. What is understood by the organ of Corti? 212.
160. What supports the ciliated cells, or rods of Corti? 212.
161. What kind of nerve-fibres supply the organ of Corti? 212.
162. What is the route of the nerve-fibres of the auditory nerve to the organ of Corti? 212.
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164. What rods of Corti respond to deep bass notes, and which to notes of higher pitch? 212.
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167. Describe the vibration of sound? 213.
168. What is understood by period of vibrations of sound? 213.
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170. On what does the variation of intensity of sound depend? 213.
171. On what does the **Intensity** of sound depend? 213.
172. What is **Wave-length** of sound? 213.
173. Are the wave-lengths shorter or longer the greater the number of vibrations of sound per second? 213.
174. What distance does **Sound** travel per second through air? 213.
175. What distance does **Light** travel per second? 213.
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177. In what manner must the vibrations of sound arrive at the ear, in order to produce a musical tone? 213.
178. What are the three essential characters of a musical tone? 213.
179. Describe the vibrations of the air, in noise? 213.
180. Are sound waves **Refractive**? 213.
181. Are sound waves **Reflective**? 213.
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183. On what does the **Loudness** of a tone of sound depend? 213.
184. What is understood by **Amplitude** of a sound wave? 213.
185. On what does the high pitch of a note depend? 213.
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193. How are overtones produced? 214.
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195. If sonorous resonance is caused by reflection, how far can the body reflecting the sound, be distant? 214.
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197. How do sound waves occur in a fluid, and a solid; and give an illustration of each? 214.
198. Give an illustration of a single sound wave, and one of continuous waves in succession? 214.
199. In what manner can sound waves be transmitted by air to a great distance? 214.
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207. What is the **Function** of the ciliæ, or rods of Corti? 215.
208. How are the impulses of sound vibrations transmitted from the ear to the auditory centre of the cerebrum? 215.
209. What qualities must sound vibrations have to stimulate the terminals of the auditory nerve? 216.
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211. What supports the cells of the organ of Corti, and on what do they rest? 216.
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CHAPTER XXII.

THE VOICE AND SPEECH.

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14. What effect have the posterior crico-arytænoid muscles on the glottis? 218.
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21. What is the function of the inferior arytæno-epiglottideus muscle during speech? 218.
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39. What is articulation of speech? 220.
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50. In ataxic aphasia, does a person really know the word he wishes to say? 221.
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14. What does melanin impart to the skin? 222.
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45. What is the function of the Pacinian bodies of the skin? 225.
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48. Of what does the corium of the skin consist? 225.
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51. Why is the dermis, or cutis vera, covered with epidermis? 225.
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MISCELLANEOUS.

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N. B.—The spelling of the word “tho” for “though” and “thru” for “through” was intentional, wherever it thus occurs.

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